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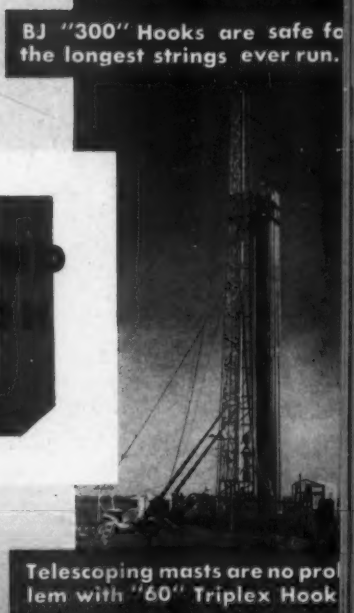

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the OIL AND GAS JOURNAL

# Trends

**Crude-Oil Production By States—Page 242**

**CRUDE-OIL STOCKS** 241,795,000 bbl. as of Dec. 18—up 1,647,000 bbl. One year ago 231,742,000 bbl.

**GASOLINE STOCKS** 72,725,000 bbl. as of Dec. 18—up 788,000 bbl. One year ago 76,141,000 bbl.

**RESIDUAL FUEL-OIL STOCKS** 58,272,000 bbl. as of Dec. 18—down 1,443,000. One year ago 74,449,000.

**GAS OIL AND DISTILLATE** 44,117,000 as of Dec. 18—down 1,393,000 bbl. One year ago 47,165,000.

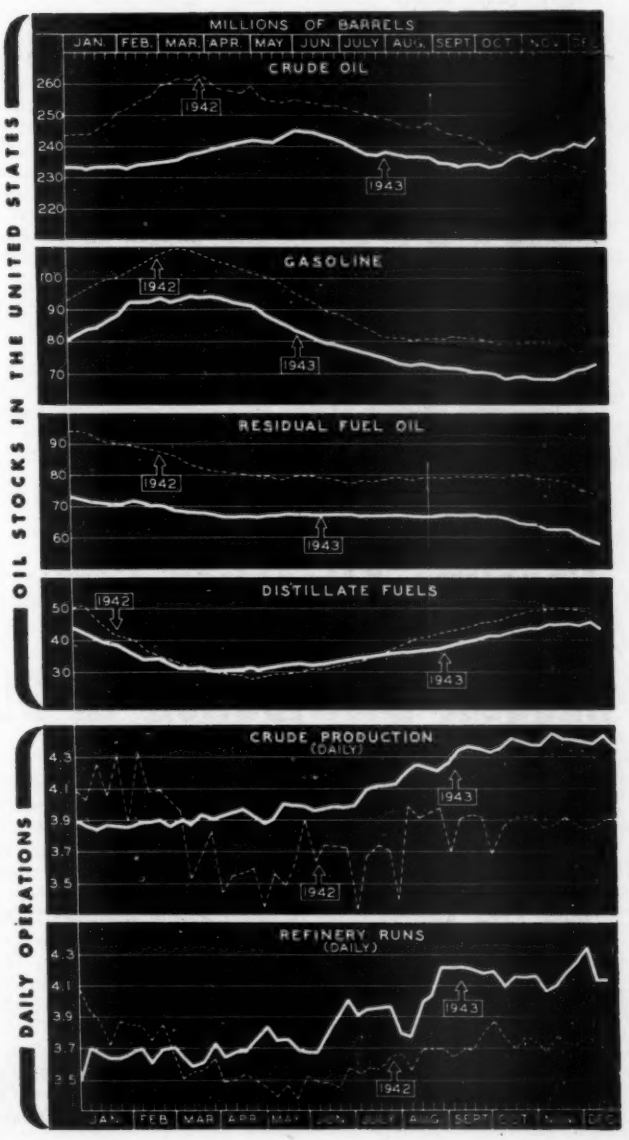
**CRUDE-OIL PRODUCTION** 4,364,640 bbl. daily average—down 36,650 bbl. One year ago 3,896,765.

**REFINERY RUNS** 4,146,000 bbl. daily week ended Dec. 18—up 2,000 bbl. One year ago 3,645,000.

ONE of the early decisions of the coming year will determine whether the shortage in gasoline supplies for civilians is to be solved by devising means to increase supplies or by more severe rationing. While of direct importance to refiners and distributors, the action that is ultimately taken will have a bearing on domestic crude-oil production and export and import movements. It is known that OPA has been making special studies of the gasoline outlook for civilians at scattered points with the view of determining whether or not remedies can be applied within the framework of the existing regulatory program.

IN this connection the Chicago regional OPA office, which includes 15 states, announced Monday that dealers, jobbers and refiners would be held to stricter account in connection with the spreading use of counterfeit coupons and other rationing irregularities. Oil companies have studied this problem of counterfeiting on their own initiative. The counterfeiting art has been perfected in some sections to the point where it is impossible for clerical help to detect spurious coupons which they handle in the checking operations. Enforcement by trained officers in the areas where this practice is spreading is the only solution to this problem, investigators state.

REPRESENTATIVES of oil-marketing companies do not feel that counterfeit coupons are the main source of trouble. Their reports on conditions in various areas are illuminating. In sections where there is little or no farm business and where there are few or no war industries civilian consumption is running 20 or more per cent under normal. In some farm and war-production areas civilian sales over the past few months have been at all-time peaks. It is felt that a tightening up in making supplementary supplies available in these areas would result in a substantial saving in gasoline supplies without injuring the farm and war-production programs for 1944. It is pointed out that the gasoline quota earmarked for nonhighway and farm consumption is 133,000 bbl. daily for the first quarter of 1944. This is 50 per cent of the gasoline required to furnish 25 million family cars with the base A ration of 3 gal. weekly. It is said that OPA has again rejected a suggested program which would have meant a complete revision in the application of rationing and if its program of tightening enforcement does not solve the shortage problem and supplies are not increased further reductions in coupon values will be made effective soon.



# President's Stand Brings Renewed Determination to Press Disney Price Bill

DETERMINATION to see the crude-oil price issue through to conclusion was expressed this week by those spearheading the effort to drive the Disney bill through Congress. Reavowal of policy by the advocates of seeking crude-oil price parity by congressional action became necessary in view of the president's assertion last week that he would veto the Disney bill if it should pass the Senate. Roosevelt, including the Disney bill with other similar price and wage legislation and resolutions pending in Congress, declared that they are "government by blackmail."

Open opposition of the administration to the Disney bill was no revelation to the oil industry. The president's declaration that it would be vetoed if passed, however, apparently removed speculation over the possibility of a compromise at the hands of the Office of Economic Stabilization or the Office of Price Administration. Some observers watching legislative progress of the Disney bill anticipated that a compromise would be offered especially if support necessary for passage appeared probable. Failure of the administration to act before the bill passed the House, however, gave preliminary indication that the executive branch of the government had decided on other strategy.

Senate action on the Disney bill will be requested shortly after Congress reconvenes January 10 although the representatives and senators guiding the legislation had not determined this week just what day it will be brought up for consideration. Proponents of the measure which would prevent OPA from fixing the crude-oil ceiling at less than 80 per cent of parity, using the 1926 commodity index as a base, asserted this week that sufficient support had been pledged in the Senate to pass the Disney measure. Even the most optimistic, however, are not certain whether support is ample for passage of the measure over the president's veto.

Current plans are to attach the bill to some piece of legislation having administration support, leaving the White House little chance but to approve it, providing, of course, that its final enactment as an independent measure becomes impossible.

# Gasoline Allocation Committee to Suggest Distribution in District 2

CHICAGO.—Appointment of a District 2 products-allocation subcommittee within the industry framework of wartime organizations was announced here last week by O. D. Donnell, president of Ohio Oil Co., Findlay, Ohio, and chairman of the general industry committee for the Middle West. The allocation subcommittee, headed by C. B. Watson, Pure Oil Co., Chicago, was created, Donnell said, in anticipation of increasing acuteness of the gasoline shortage. First meeting of the new subcommittee will be in Chicago, January 6.

The subcommittee's assignment is to work out a program of equitable allocation of available supplies for submission to the Petroleum Administration for War. Recommendations to PAW will be submitted for "whatever action it may deem advisable in the premises," Donnell said.

Members of the committee, in addition to Chairman Watson, are: Reid Brazell, vice chairman, Leonard Refineries, Inc., Alma, Mich.; W. J. Carthaus, Deep Rock Oil Corp., Chicago; M. E. Foster, Phillips Petroleum Co., Bartlesville, Okla.; Robert W. Fyfe, Standard Oil Co. (Indiana), Chicago; D. B. Hodges, Shell Oil Co., Inc., New York; R. R. Kibbe, Texas Co., Chicago; W. M. McEldowney, Gulf Oil Corp., Pittsburgh, Pa.; H. L. McReynolds, Socony-Vacuum Oil Co., Inc., Kansas City, Mo.; C. S. Rosenthal, Apex Motor Fuel Co., Chicago; Ross K. Schoolroy, Fair Price, Inc., Wooster, Ohio; A. H. Sus, Sinclair Refining Co., Chicago; H. M. Tartt, supply and distribution committee for District 2, Chicago; Everett Wells, Ashland Oil & Refining Co., Ashland, Ky.

Current stocks of motor fuel in District 2 reported by the A.P.I. summary stand at 20,882,000 bbl., compared to 22,541,000 bbl. at midyear and 22,545,000 bbl. at the start of 1943.

## Gates Made Tropical's Field Manager

TORONTO, Ont.—John M. Gates, a veteran of nearly 20 years' service with Tropical Oil Co., has been appointed field manager with headquarters at El Centro, Colombia. He was born in Vinita, Okla., although his home state is California. He followed the oil business from boyhood and the only interruption in his long and active service in the industry came during the first World War. Then he served overseas with his regiment, engaging in active fighting in France.

Gates chose foreign oil service as a career and about two-thirds of his more than 30 years' experience has been with Tropical in Colombia. He joined that company in 1924 and for the next 10 years successfully occupied positions of driller, tool pusher, and drilling superintendent.

Since his service with the company dates almost to the beginning of active development on the De Mares concession, he is thoroughly familiar with the history of operations in that field. Under his supervision nearly 1,200 successful wells have been completed in the field in addition to drilling of numerous wildcats in outlying areas. This experience, together with his natural bent, has made him a recognized authority on Colombia.

In 1939 he was made assistant field manager and since that time his scope of responsibilities has included all the various activities connected with actual operations in South American oil fields.

On November 1 this year he was promoted to field manager.

Gates' versatility extends into the lighter side of life and not least among his assets are a quick wit and a rare sense of humor. His close associates are ready to swear his repertory of anecdotes is so vast that, together with a good memory, he has yet to repeat himself before the same audience.

# Midwestern Refiners Discuss DSC Freight Reimbursement Proposal

CHICAGO. — With the shortage of their crude supplies causing rising concern, Midwest refiners met here this week to consider the reimbursement plan adopted by Defense Supplies Corp. to effect movement of West Texas oil by tank car so that idle refining capacity may be put to use. The feature of the plan which has stirred vigorous protest prohibits participation in it of any company in the excess-profits bracket.

More than 20,000 bbl. of West Texas crude is being moved by tank car daily from Midland to the Atlantic Refining Co. plant at Philadelphia, under the compensatory plan which has been in effect in the East since early in the war. It is planned to move approximately 40,000 bbl. daily to the Midwest by rail. To handle this crude, 3,000 additional cars were made available recently.

Approximate amounts per barrel which will be paid by DSC to refiners in District 2 under the compensatory plan in connection with tank-car shipment of West Texas crude were announced last Saturday by Secretary of Commerce Jesse Jones. A list of various points of origin and destination and the amount of the differential in each case as determined by PAW is shown in the accompanying table.

## Standard of Ohio Expands Available Operating Funds

CLEVELAND, Ohio. — Common stockholders of the Standard Oil Co. (Ohio) last week approved a new issue of $10,138,900 aggregate par value of cumulative convertible preferred stock ranking on a parity with the $12,000,000 aggregate par value of 5 per cent cumulative preferred stock now outstanding.

In a letter to shareholders, W. T. Holliday, president of the company, stated: "The purpose of the proposed issuance of the new preferred stock is to provide new capital for the expanding operations of the company. The company has been making heavy capital expenditures for the last few years, largely for improvements in and additions to the company's refining facilities and for the acquisition and development of crude-oil producing properties.

"It is expected that continued expansion in production activities and probable capital expenditures in the refining department, together with other capital expenditures, are likely to be too great to be paid out of the company's general funds. The company has no specific capital expenditures under consideration other than for the completion of its catalytic cracking unit, now under construction, and other than expenditures considered to be in the ordinary course of business or not of major importance."

## State Requests Test on Florida's Discovery Well

TALLAHASSEE, Fla. — Whether there is enough oil in the Sunniland discovery well to support a claim for the $50,000 reward offered for the first commercial well in Florida hinges upon a 30-day production test to be made at the request of state officials. Atty. Gen. Tom Watson said he had notified officials of Humble Oil & Refining Co., owner of the well, that state geologists would be on hand December 29 to start recording the well's output.

In claiming the state reward, Humble officials offered to donate half the amount to Florida State College for Women and half to University of Florida as scholarship funds.

### REIMBURSEMENT SCHEDULE FOR TANK-CAR SHIPMENT OF WEST TEXAS CRUDE OIL

| Destination— | Origin | | |
|---|---|---|---|
| | Levelland | Midland | McCamey |
| Allen, Okla. | $.7824 | $.7408 | $.8074 |
| Alma, Mich. | 1.2405 | 1.3076 | 1.3278 |
| Ardmore, Okla. | .7824 | .7408 | .7968 |
| Arkansas City, Kans. | .7824 | .7408 | .8074 |
| Augusta, Kans. | .7358 | .7408 | .7608 |
| Barnsdall, Okla. | .7824 | .7874 | .8074 |
| Bay City, Mich. | 1.2405 | 1.3076 | 1.3278 |
| Blue Island, Ill. | .7878 | .8550 | .8750 |
| Bristow, Okla. | .7358 | .7874 | .8074 |
| Canton, Ohio | 1.1783 | 1.2455 | 1.2655 |
| Castleburg, Ky. | 1.1633 | 1.1883 | 1.1883 |
| Carson City, Mich. | 1.1783 | 1.2455 | 1.2655 |
| Centralia, Ill. | .6235 | .6808 | .7106 |
| Chanute, Kans. | .7358 | .7408 | .8074 |
| Cleveland, Ohio | 1.1783 | 1.2455 | 1.2655 |
| Cleveland, Okla. | .7824 | .7874 | .8074 |
| Cleves (Cincinnati) | 1.0808 | 1.1479 | 1.1679 |
| Coffeyville, Kans. | .7824 | .7874 | .8074 |
| Cushing, Okla. | .7824 | .7408 | .8074 |
| Cyril, Okla. | .8892 | .7563 | .8074 |
| Drumright, Okla. | .7824 | .7874 | .8074 |
| Duncan, Okla. | .7202 | .7252 | .8074 |
| Dupo (East St. Louis) | .8067 | .8585 | .8785 |
| East Chicago, Ind. | .7878 | .8550 | .8750 |
| East St. Louis | .8067 | .8585 | .8785 |
| Eldorado, Kans. | .7358 | .7408 | .7808 |
| Enid, Okla. | .7824 | .7408 | .8074 |
| Findlay, Ohio | 1.1451 | 1.1812 | 1.2012 |
| Flat Rock, Mich. | 1.1983 | 1.2655 | 1.2855 |
| Garnett, Kans. | .7824 | .7408 | .7808 |
| Gary, Ind. | .7878 | .8550 | .8750 |
| Grandfield, Okla. | .8425 | .8786 | .8074 |
| Grand Rapids, Mich. | 1.1472 | 1.1833 | 1.2033 |
| Heath, Ohio | 1.1472 | 1.1833 | 1.2033 |
| Indianapolis (R. I.) | .9054 | .9414 | .9614 |
| Kalamazoo, Mich. | 1.0540 | 1.0901 | 1.1101 |
| Kansas City, Kans. | .7892 | .7408 | .7808 |

| Destination— | Origin | | |
|---|---|---|---|
| | Levelland | Midland | McCamey |
| Latonia, Ky. | 1.1429 | 1.1479 | 1.1679 |
| Lawrenceville, Ill. | .7878 | .8550 | .8750 |
| Lemont, Ill. | .7878 | .8550 | .8750 |
| Lima, Ohio | 1.1290 | 1.1651 | 1.1851 |
| Lockport, Ill. | .7878 | .8550 | .8750 |
| Louisville, Ky. | .7794 | .8154 | .8354 |
| McPherson, Kans. | .8446 | .8961 | .9161 |
| Memphis, Tenn. | .5661 | .5711 | .5911 |
| Midland, Mich. | 1.2405 | 1.3076 | 1.3278 |
| Mount Pleasant, Mich. | 1.2405 | 1.3076 | 1.3278 |
| Mount Vernon, Ind. | .8843 | .9204 | .9404 |
| Muskegon, Mich. | 1.2122 | 1.2383 | 1.2583 |
| Nashville, Tenn. | .7304 | .7354 | .7554 |
| Neodesha, Kans. | .7358 | .7408 | .8074 |
| Oklahoma City, Okla. | .7824 | .7408 | .8074 |
| Pana, Ill. | .7323 | .7839 | .8039 |
| Phillipsburg, Kans. | 1.1398 | 1.1914 | 1.2114 |
| Ponca City, Okla. | .7824 | .7408 | .8074 |
| Potwin, Kans. | .8446 | .8961 | .9161 |
| Pryse, Ky. | 1.1926 | 1.1976 | 1.2176 |
| Robinson, Ill. | .7878 | .8550 | .8750 |
| St. Elmo, Ill. | .7478 | .8150 | .8350 |
| St. Louis, Mich. | 1.2405 | 1.3076 | 1.3278 |
| Saginaw, Mich. | 1.2405 | 1.3076 | 1.3278 |
| Salem, Ill. | .8235 | .8808 | .7106 |
| Sand Springs, Okla. | .7824 | .7408 | .8074 |
| Shallow Water, Kans. | .9223 | 1.1293 | 1.2736 |
| Sheboygan, Wis. | .8359 | .8873 | .8075 |
| Stroud, Okla. | .7824 | .7874 | .8074 |
| Toledo, Ohio | 1.1351 | 1.1812 | 1.1912 |
| Trenton, Mich. (Earhart Sta.) | 1.1983 | 1.2655 | 1.2855 |
| Troy, Ind. | .7843 | .8204 | .8404 |
| Tulsa, Okla. | .7824 | .7408 | .8074 |
| Whiting, Ind. | .8078 | .8750 | .8950 |
| Wichita, Kans. | .7358 | .7408 | .7808 |
| Wood River, Ill. | .8067 | .8585 | .8785 |
| Wynnewood, Okla. | .7824 | .7408 | .4968 |

# California Operators Invited to Seek Closer Spacing Where Conditions Warrant

*by E. L. Davis**

**These excerpts are from a paper presented December 21 at a meeting of the Los Angeles Basin Chapter, American Petroleum Institute, held at Long Beach, Calif. The author sets up a standard of 1 bbl. of new oil for each ton of steel expended as reasonable in requesting exceptions to spacing orders. He urged all operators to consider each possible location strictly on its merits and in terms of new production which will be made available, regardless of spacing restrictions. Operators are invited to apply for exceptions to Supplementary Order 4, when justified.**

AS recently as 2 years ago, California producers were required to curtail their production in order to conform with the demands for petroleum at that time, which were about 620,000 bbl. a day. Due to the method of allocation of production, based upon individual well potentials, each operator established as high a potential as possible. In most cases these estimates of potentials were probably reasonable but represented only the flush capacity of the wells involved, disregarding the performance of the oil reservoir as a whole.

After our entrance into the war, it immediately became necessary to make an appraisal of sustained capacities of California pools, and the previously estimated potential of 3,700,000 bbl. daily was quickly deflated to a maximum efficient rate—that is, a capacity which could be sustained for a 6-months' period without damage to the reservoir—of 901,500 bbl. a day. In a short time petroleum demands in this district rose from their prewar levels to meet and pass the declining curve of maximum efficient rate of production, with the result that although allowable production has been limited only by these maximum efficient rates, it has been necessary to withdraw substantial quantities of petroleum products from storage.

### Supply Issue Forced

Despite the materials shortages and apparently adequate supply of oil, a forceful presentation of the fuel-oil problem of this district, prepared and backed by the oil industry, industry committees, and PAW, successfully pushed through a program of reduced spacing in those California fields producing heavy oil, and provided the materials required by that program.

Another effort to meet the continued rising demand for fuel oil took place in July of 1942 when the Petroleum Administrator issued a directive to the oil refineries to increase the fuel-oil yield of the crude run, by reducing the yield of civilian gasoline. For an industry formerly based on the sale of motor fuel, this was revolutionary.

So long as the demand for other petroleum products remained moderate, these measures proved reasonably effective in reducing the withdrawal of fuel oil from storage; but now that the demand for other products also exceeds the available supply, there is only one conclusion: There is simply not enough oil to go around.

One demand that was not fully appreciated was a military demand for gasoline, for both aviation use and for motor fuel. Fortunately for the war effort but perhaps unfortunately for the local motorists, California oils provide large quantities of excellent base stock for aviation gasoline which are being utilized to the greatest extent possible for that purpose and correspondingly reduce the quantity of motor gasoline available for the public; also, some quantities of the gasoline fraction are being used for butadiene stock. These demands are expected to increase rather than to decrease in the future.

In an attempt to meet the increased demand and to avoid wasting the still critical steel, spacing requirements for the drilling of new wells have been progressively reduced in those fields which were likely to yield the best returns in available oil. In addition, the engineering subcommittee, at the direction of the District 5 production committee, continually reviews the rates of production in the restricted pools in order to be certain that each pool is in fact being produced at the maximum safe rate. These increased rates of production, however, have one unavoidable fault: They accelerate the decline of the production rates and make less oil available in the future. The only satisfactory solution of the problem is to provide more production by drilling more wells, where such wells will actually increase the amount of oil available, and to discover new pools.

At our present rate of use, we would need to discover and develop every year a new pool equivalent to a Wilmington or a Coalinga Nose. As you know, discoveries are far short of that goal. In this emergency we cannot afford to delay, but must do our utmost by drilling additional wildcats wherever the prospects justify such drilling and by drilling up all available undrilled reserves.

### Materials Assured

In order to facilitate such drilling, materials have been made available for exploratory drilling and for additional development. We have been assured that such material will continue to be available.

You as oil men close to field operations know best where wells can be drilled which will yield favorable returns, and I urgently request that all such wells be drilled without delay. As you know, all drilling authorized by the PAW is on a basis as uniform as possible, so as to minimize steel expenditure, provide proper drainage for the oil pools and be fair to each operator in proportion to his interest. Therefore, any proposals for drilling not in line with the spacing provisions of Supplementary Order 4 to Petroleum Administrative Order 11, should be on drilling units of such size as would be justified for all other wells in the same pool. Also, such drilling should provide the greatest returns possible in oil for the amount of steel expended, since steel remains critically scarce. In order to be desirable, 1 bbl. a day of oil should be made available for each ton of steel expended.

The district office has been empowered to grant exceptions to the SO-4 order on reduced spacing standards where justified by merit. Inability to conform with the standards of that order should not, therefore, stand in the way of meritorious drilling.

*Assistant director of production, PAW District 5.

# THIS WEEK

**REFINING**—Eleven more 100-octane aviation-gasoline plants completed within the past 90 days. . . . Major 100-octane projects now completed stand at 34, represent 71 million dollars out of 900-million-dollar program. . . . ¶Midwest refiners hear plea to use DSC reimbursement program for moving West Texas crude oil to District 2 plants. . . . Manufacturers object to contingencies inserted in DSC offer, particularly that excluding companies in excess-profits bracket from receiving compensation. . . .

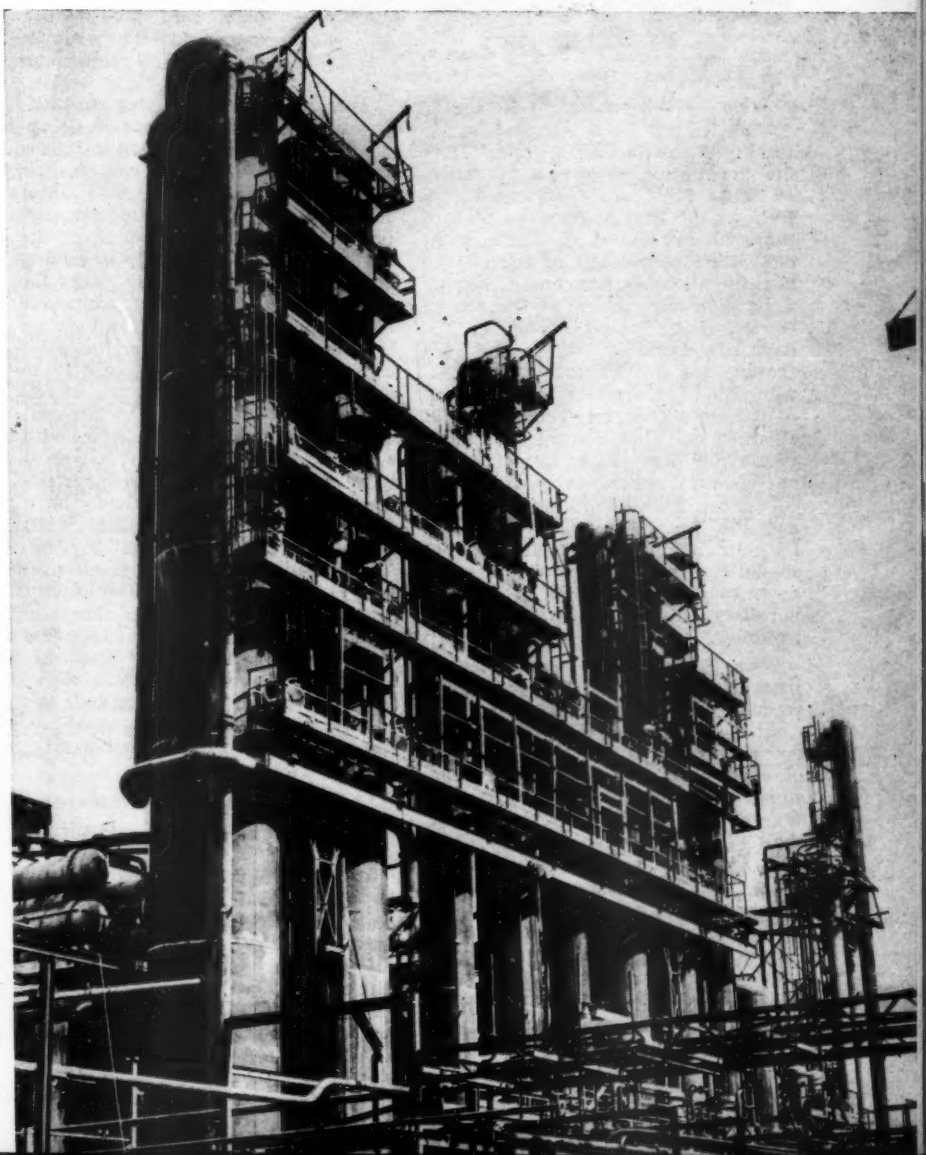
**SUPPLIES**—Acute motor-fuel shortages anticipated in Districts 2 and 5 next spring and summer. . . . ¶Cut in coupon values on Pacific Coast expected by most refiners. . . . ¶General industry group sets up allocation committee in District 2, to cope with imminent shortage, to recommend equitable distribution. . . . Counterpart of Directive 59 may be issued for District 2, not immediately but within 4 to 6 months. . . . ¶PAW liberalizes kerosene specifications on East Coast, permitting refiners to take deeper cut. . . . ¶More speed urged in completing aviation-gasoline plants. . . . ¶Appeals for workmen issued by WMC offices in Rocky Mountains, where construction progress is lagging. . . .

**TRANSPORTATION**—Refinery products accumulated in storage at Beaumont, Tex., preparatory to starting runs through 20-in. line. . . . ¶WPB and PAW approve Stanolind Pipe Line Co.'s 8 and 10-in. project from Elk Basin field to Casper, Wyo. . . . Initial capacity will be 21,500 bbl. daily, potential-designed throughput will be 45,000 bbl. a day. . . . Line will increase capacity for supplying District 2 refineries but deliveries also could be made to Denver or Salt Lake City. . . . ¶Gasoline movement by pipe line totals 36 per cent of aggregate production. . . .

**PRODUCTION**—District 5 operators urged to apply for spacing exceptions on meritorious locations. . . . Approximate standard of 1 bbl. new oil per ton of steel expended suggested as reasonable ratio. . . . ¶PAW reported working on amendment to PAO 11, liberalizing restrictions on multizone completions. . . . ¶Eighteen special orders issued in Texas last week approving dual completions, indicating growing acceptance of technique, for the sake of increasing production. . . .

**PRICES**—Sponsors of Disney bill reaffirm determination to drive act through Congress. . . . President's assertion that it will be vetoed, if passed, ends all hope for relief through executive action. . . . Supporters believe Senate will pass measure, are doubtful of sufficient strength for overriding veto. . . . Question still debated, however, whether president will accept responsibility for shortages down the line. . . .

**MATERIALS**—Supply of tubular goods in approximate balance with requirements. . . . Shortages of tool joints and drill collars being cleared up by rescheduling operations of certain manufacturers, diverting war contracts, turning facilities to production of oil equipment. . . .



*New alkylation plant at Pure Oil Co.'s Smith Bluff, Tex., refinery (owned by Defense Plant Corp. and operated by the Pure Oil Co.) It will produce large quantities of an important component for 100-octane gasoline. Start of manufacturing operations at this unit was announced December 24*

# Undiscovered Reserves Equal to Those Already Found Held Probable

*by Wallace Pratt**

*WALLACE PRATT*

OVER the last generation the United States has been engaged in becoming a "nation on wheels." Over the same period, petroleum, the source of liquid fuels, our most convenient form of the energy required to turn those wheels, and of lubricants, without which no amount of energy can turn those wheels, has come to occupy a position very close to the top of the list of our basic commodities. Today, in a world of plastics and synthetics, a world exploded into total war, the hydrocarbon molecules of petroleum take on an even more vital significance. They become the fundamental building blocks out of which our chemical industries construct the rubber for essential military transport and the even more important TNT for our bombs and high-explosive shells. Barring the conquest of some new, revolutionary form of energy, petroleum must continue to be one of America's paramount necessities.

What then of our reserves of petroleum for the future? The petroleum resources of the earth are a wasting asset. So far as the needs of mankind are concerned, there is no renewal of supply. How large, then, are the stores of petroleum available to us? Where are they situated? How soon shall we be obliged to substitute other raw materials for petroleum as a source of liquid fuels?

The following pronouncement is typical of the prevailing climate of American opinion on the state of our petroleum reserves:

"Over the last 3 years our discoveries of new petroleum reserves have consistently failed to balance our annual consumption. Our proved reserves now bulk some 20 billion barrels, a quantity equal to our national requirements for 15 years in peace, or 13 more years of war."

This oversimplified statement lends itself to misleading inference. It appears to confuse rather than to inform the average reader. It contains no hint, for example, that the real causes for the decline in our rate of discovery of new oil fields throughout the period of the war and the preceding emergency are subnormal prices for crude oil and shortages of manpower and critical materials. Not only is there no encouragement for the wildcatter to find more petroleum; there are positive restraints on his activities. In normal times when exploration lags we stimulate the effort with a price raise for crude oil. Given a price incentive and relief from restrictions, the industry would surely have drilled twice as many wildcat wells as it did drill over the past 2 years. And this additional exploration would surely have boosted our discovery rate sharply. All that our domestic oil-finding effort needs is the stimulus of crude-oil-price increases plus adequate manpower and critical materials. When these are supplied our discovery rate will rise again and our proved reserves will be further augmented.

### Distorted Reserve Picture

Again, the announcement quoted presents our proved reserves in a light which makes them appear to the casual reader to constitute our total domestic petroleum resources. They are not our total resources. Experience amply justifies the hope that future petroleum discoveries in the United States will exceed our total past discoveries. These past discoveries aggregate some 45 billion barrels.

Our statement also ignores our proved reserves of natural gas which, measured in terms of available energy, are equivalent to an additional reserve of about 17 billion barrels of liquid petroleum. Natural gas is petroleum in gaseous form and with modern equipment and technique, natural gas can be converted into liquid fuels at unit costs only slightly higher than are involved in the conversion of liquid petroleum. Reserves of natural gas, therefore, are practically equivalent to an equal weight of liquid petroleum.

### Foreign Holdings Ignored

Finally, the estimate of 20 billion barrels of proved petroleum reserves omits reserves discovered by Americans in their operations in other countries during the last 30 years. The proved reserves remaining in the foreign properties of American nationals constitute another 20 billion barrels, or more.

The total proved reserves of petroleum already discovered and developed by Americans, at home and abroad, therefore, are of the order of 60 billion barrels, a reserve more nearly commensurate with the needs of the nation than the commonly estimated 20 billion barrels.

One fact which may be deduced from the statement we have had under consideration is that our ordinary peacetime consumption of petroleum in the United States amounts to 450 gal. annually per capita. Compare this index of consumption with that for the average citizen of the rest of the world, which stands at 15 gal. The average American consumes 30 times as much petroleum as the average citizen in the rest of the world.

The significance of our abundant use of petroleum becomes evident when we convert it into its equivalent in mechanical work. The available energy from our output of petroleum is equivalent to the work of

*Vice president, Standard Oil Co. (N. J.)

4.5 billion men, laboring 8 hours a day, 6 days a week, year in and year out. In effect our petroleum provides us with an average of 36 strong, ablebodied slaves for every man, woman and child in the United States. The culture of ancient Greece, we are told, was founded upon slave labor. High standards of living are supported by large production of goods per capita. Large production means either the labor of many men or the mechanical work of power-driven machines and labor-saving devices.

We believe that Hitler's gigantic efforts at conquest were designed to reduce to slavery the entire population of Europe. On the slave labor of these people, Hitler planned to erect a preferred status for the "master race," Germany. But if Hitler had conquered the whole world and enslaved all humanity, the human manpower under his lash would have amounted to less than one-tenth of the mechanical manpower that has been at the disposal of Uncle Sam for years in the form of petroleum molecules. So puny is the loot of the mightiest warrior compared to the most prosaic fruits of peace! So effective a basis for a high standard of living in an abundance of petroleum!

### Factors in Development

This fortunate condition, this supply of petroleum so far in excess of that any other nation has enjoyed, is due, we are commonly asked to believe, to the fact that our country has been blessed with unusually rich natural resources of petroleum. This is a mistaken belief. If we accept it, we must ignore another even more precious heritage with which as a nation we have been blessed. The facts are that the really rich petroleum resources of the earth in comparison with which our own resources appear meager, lie outside our national boundaries. Of the areas of first-class promise for petroleum over the earth's surface, aggregating some 6 million square miles, about 15 per cent, or less than 1 million square miles, lie within the United States. When the petroleum resources of the earth have finally been fully developed, it will probably be established that less than 15 per cent of the total resources of the earth are included within the United States.

What we have been blessed with in the United States is a native genius, combined with political and social concepts which have enabled us to explore for petroleum more effectively and to discover petroleum more rapidly in our own country than any other people on earth. We have enjoyed an abundance of petroleum resources in America because we have gone out and searched for petroleum all over our country until we found it.

We have brought to the task of petroleum-finding, in addition to the methods of applied science, the spirit of the pioneer. To a native ingenuity which enabled us to design and operate the ponderous mechanical equipment necessary to drill and recover petroleum from wells of unprecedented depth, we have added the frontiersman's characteristic risk-taking instinct. Driven by this instinct, armed with this machinery, we have gone about over our land, thousands of us in small, "wildcatting" enterprises, drilling tens of thousands of exploratory wells every year for a generation, in search of petroleum. Our geographical frontiers having already been subdued, we have reached out in the vertical dimension, beneath the surface of our land, a new frontier. The conquest of this new frontier has brought us our abundance of petroleum.

**AMERICAN PETROLEUM RESERVES***

| Type and location— | Barrels |
|---|---|
| Domestic crude oil | 20,000,000,000 |
| Contained in natural gas | 17,000,000,000 |
| American controlled (foreign) | 20,000,000,000 |
| Proven supply | 57,000,000,000 |
| Possible future discoveries | 45,000,000,000 |
| Proven and potential supply | 102,000,000,000 |

**AMERICAN CONTROLLED FOREIGN RESERVES***

| | |
|---|---|
| Near East | 13,300,000,000 |
| South America | 6,700,000,000 |
| Total foreign | 20,000,000,000 |

*Compiled from accompanying discussion.

### Exploration Lags Elsewhere

Every nation has this same frontier, but no other nation has explored it as we have. Other nations have failed to develop their own petroleum resources even where the natural obstacles to success were no more difficult than our own. We, too, might have failed had we not enjoyed our traditional political freedom. The methods we have employed could not succeed in any other than an atmosphere of democratic free enterprise. Had ours been a highly centralized government, the search we have carried out would have been impossible. Had our economic society been rigid with class distinction, our success, at best, would have been slower and less complete. Restrictions by the state of the right to drill exploratory wells; state ownership of minerals; state monopoly of the rights to explore; any of these conditions gravely handicap the development of petroleum resources. Even the existence of a landed gentry with unbroken ownership of large areas, in contrast to our widely divided ownership in small tracts retards exploration and depresses the rate of discovery. Over much of the earth political and social barriers have prevented any effective effort to develop petroleum resources.

In so far as the petroleum resources of the earth have been developed the exploration, outside of Russia, has been carried on almost entirely by private enterprise in the hands of American, British and Dutch citizens. Most of the really great oil fields of the earth have been found around the margins of the land-locked seas which occupy the depressions between the continents where these approach each other most closely. In the Near East around the margins of the Mediterranean, Red, Black and Caspian seas, lying between the continents of Africa, Europe and Asia, are the prolific oil fields of Russia, Iran, Irak, Arabia and Egypt. Around the margins of the Caribbean Sea and the Gulf of Mexico, lying between the continents of North and South America, are the oil fields of Mississippi, Louisiana, Texas, Mexico and northern South America. On the large islands of Borneo, Sumatra, Java and New Guinea in the vast land-locked sea which separates the continent of Australia from Asia, are the principal oil fields of the Orient. The proved reserves of petroleum in these three regions, excluding Russia and the United States, are of the order of 40 billion barrels. They constitute more than 90 per cent of the total known petroleum reserves of the earth, outside Russia and the United States. The Near East alone accounts for some two-thirds of the earth's proved reserves outside of Russia and the United States.

### Russia's Claims

If we look at the petroleum reserves of the first-rank nations, we find Russia claiming first place. In the years immediately preceding the war Russia published estimates which placed her proved reserves at 45 billion barrels. British companies hold 50 per cent or more, of the proved reserves of the Near East, two-thirds of those in the Far East and about one-quarter of those in the Western


## Index Available

**The complete editorial index of The Oil and Gas Journal for 1943 will not be incorporated in a regular issue, but will be printed separately. This 1943 index will be sent without charge to all subscribers requesting a copy by January 10. Only as many copies will be printed as there are requests at the time the index goes to press. This is made necessary by the paper shortage. Address requests to Circulation Department, P.O. Box 1260, Tulsa.**

Hemisphere, outside the United States. American citizens have developed about 40 billion barrels of petroleum reserves, one-half of them at home, one-third in the Near East and the balance largely in northern South America. None of these estimates makes any allowance for reserves in the form of gas which, as we have noted, add materially to the proved reserves in the United States.

Russia's potential petroleum resources are enormous. In the region of the Caspian and Black seas, she owns an important fraction of the petroleum resources of the Near East. Here are situated her oldest and most prolific oil fields. Northward from the Caspian, for 2,000 miles along the flanks of the Ural Mountains to the Arctic Coast, Russia has developed a series of producing oil fields. Similarly, from the Caspian eastward for 1,500 miles to the borders of Sing Kiang Province in China, Russian oil fields are under development. At various places along the Arctic Coast of Siberia, over a distance of 3,000 miles, Russian engineers have been engaged for several years in drilling oil wells. On the Pacific, or eastern coast of Siberia, on Kanchatka Peninsula and Sakhalin Island, petroleum has been known and produced for two decades now. Finally, over "a distance of 1,000 miles" along the tributaries of the Lena River in eastern Siberia promising sources of petroleum are being explored and developed. More nearly than any other first-rank nation, Russia appears to be self-contained as to petroleum.

The proved-petroleum reserves of the earth at the present time (excluding gaseous petroleum) appear to exceed 100 billion barrels. But no part of the earth outside the United States has been explored with any degree of thoroughness. When effective search has spread over the entire land surface of the earth, we may expect to find a great deal more petroleum.

As long ago as 1888 Edward Orton, a distinguished American geologist, observed:

"It is obvious that the total amount of petroleum in the rocks underlying the surface . . . is large beyond computation."

Since Orton's time we have made extensive surveys of the petroleum-bearing rocks. In these studies we have included the rocks of the present sea floors as well as those of former seas. From this research we have learned that in some places, such as the Black Sea, organic matter constitutes as much as 40 per cent by weight of the rocks now being formed on the floors of shallow seas. From the data we have collected we estimate the average organic content is the rock floors of all our shallow seas at 2.5 per cent.

Petroleum and coal, our mineral fuels, are the fossil sunlight of 2,000 million years of earth history. In coal, which forms only on land, we have preserved for us the energy of the light which bathed the surface of the land. In petroleum, formed in the seas adjacent to land, is the energy of the light which fell upon the waters. The known coal resources of the earth we estimate in the thousands of billions of tons—7,500 billion long tons—but the petroleum resources of the earth we think of only in tens of billions of tons. Why this great discrepancy? What has become of all the organic matter that fell to the bottoms of our former seas? Has the life of the sea been so much less than that of the lands?

### Rate of Organic Deposits

The present land surface of the earth has an area of about 60 million square miles. Of this total, some 22 million square miles had been covered at times by shallow seas and is composed of rocks that were formed on the sea floors, rocks which commonly enclose petroleum reservoirs. Of this area the rocks of first-class promise for petroleum cover 6 million square miles; the remaining 16 million square miles is of lesser promise. Let us consider only this area of first-class promise for petroleum, 6 million square miles, and apply to the rocks underlying it within the moderate depth of 1 mile only, the figure for the average organic content in the rocks of sea floors, namely, 2.5 per cent. If we do so we are at once confronted with a quantity of organic matter originally present in these rocks alone 10 times greater in weight than all the known coal resources on earth. If only one-tenth of 1 per cent of this organic matter had been converted to petroleum and concentrated in the pore spaces of the enclosing rocks, the earth's petroleum resources would be 10 times greater than the total known reserves. In the light of these facts, it seems reasonable to suspect that a great deal of petroleum remains yet to be found in the earth.

There are many nations in the world which suffer from a lack of petroleum. Many of these nations have within their own borders potential sources of petroleum supply. These potential resources should be developed. If abundant, low-cost petroleum were available to every nation, standards of living could be raised materially throughout the world. At many remote places adequate transportation and mechanical energy can be made available only through cheap liquid fuels, such as are produced from petroleum.

Here is a task which American private enterprise is well qualified to undertake—the development of the petroleum resources of the earth. Our past record both at home and abroad amply demonstrates our competence. The comfortable situation which the United States occupies with respect to petroleum reserves is the result of private initiative. The history of the petroleum industry throughout the world demonstrates that finding and recovering petroleum are enterprises which do not lend themselves to successful performance by the state. Over the last 30 years a number of governments have seized petroleum reserves previously developed by private enterprise and in some cases these governments have succeeded in expanding production from the seized properties. But no government has yet succeded in developing sufficient petroleum production to meet the needs of its own people, even from seized properties. None of the many state-operated petroleum monopolies makes a significant contribution to the stream of petroleum which flows into world commerce today.

The contribution which governments can well make to the development of the petroleum resources of the earth is to facilitate the spread of free enterprise throughout the world. If the methods of the American petroleum industry, through the diplomatic support of the American Government, and the friendly cooperation of other governments could be extended into all countries in an industrial crusade to discover and develop the petroleum resources of the earth, a great stride would have been taken toward permanent peace in the world.

## Elk Basin-Casper Line Officially Approved

WASHINGTON, D. C.—A new crude-oil pipe line from the Elk Basin field to Casper, Wyo., has been approved by PAW and WPB.

The line will be built by Stanolind Pipe Line Co. and will consist of 70 miles of 8-in. from Elk Basin to the Little Buffalo field and 160 miles of 10-in. from there to Casper. Construction will start in early spring and is scheduled for completion in September 1944. Estimated cost is $4,200,000. With two pumping stations, the line will have capacity to Casper of 21,500 bbl. per day which can be increased to 45,000 with additional stations.

From Casper the oil could move east via Stanolind's line to District 2, which may be short of crude by summer because of declining production in other Wyoming fields; or south to Cheyenne and Denver via Rocky Mountain Pipe Line; or west to Salt Lake City via Utah Refining Co. system which ties in with Stanolind at Fort Laramie, Wyo., together with the recently authorized Yale Pipe Line from Elk Basin to Laurell and Billings, Mont., refineries.

FOUNDED IN 1910

BY PATRICK C. BOYLE

the OIL AND GAS JOURNAL

# A Petroleum Peace

IT is an open secret that in the conferences at Moscow, Cairo, and Teheran concerned with plans for the postwar world, discussions centered in the future development and distribution of petroleum. Its availability in required quantities is expected to bring the European conflict to a successful end for the Allies within a year. Essential in war, the statesmen of the United Nations are more and more impressed with the fact that petroleum is the world product on which a just and lasting peace must be founded.

While those attending the conferences may feel that the exigencies of war and peace justify a confidential arrangement as to what is planned, actually the operating and consuming base for what must be the world's petroleum program, as reported in this International Number, is an open book.

The U.S.S.R., the British Empire, and the United States account for 83 per cent of the world's petroleum consumption, of which this country has approximately 70 per cent. Comparatively unimportant now, a freed and revitalized China will rapidly become a major user of petroleum products. These four nations, which will have the principal responsibility in inaugurating and maintaining peace, have a primary duty in seeing that their own peoples continue to have ample oil supplies.

Then there are the additional hundreds of millions of the world's population, including primitive peoples who, before the war, were just beginning to use petroleum. The intricate economies of Europe's smaller nations must have petroleum products in substantial quantities as soon as they are freed from the enemy.

Germany and Japan, when they are once more within their own boundaries, will not have sufficient petroleum, including substitutes, to provide a small fraction of their needs.

Relative to supplies, this country, unless new discoveries greatly increase in the postwar period, will quickly become a net importer of the world's most important source of power. The U.S.S.R., with large reserves and promising areas yet to be explored, will need its present and future oil to carry on the large-scale expansion, already outlined, of its peacetime economy.

Its own petroleum resources of minor importance, the British Empire is largely dependent on concessions of its government-controlled company and its nationals operating in both hemispheres. In the eastern areas of the Eastern Hemisphere and in the northern South American countries are most of the world's oil in excess of local needs.

With conditions in regard to supply and demand apparent, there remains only the question of how best to produce and distribute after the close of the war. The recent report of the Foreign Operations Committee furnishes the oil industry's answers to that query.

In brief, that committee recommended that the search for and the development of future oil continue as a private enterprise, with provision made to assure the protection of nationals of this and other countries. Government participation, so far as this country is concerned, should end at the conclusion of the emergency. This program offers the only guarantee of supplies at prices and in quantities which will aid in rounding out an equitable world economy—the foundation upon which a prolonged peace must be built.

# Number of Rotary Rigs in Operation Rises to 1,350, a Peak for the Year

*by Frank A. Watts**

**This report on current drilling operations, the outlook for future months and prospects for obtaining necessary materials was presented at the most recent meeting of the Petroleum Industry War Council. Necessity for projecting equipment requirements as much as 6 months ahead is stressed in order that manufacturing schedules may be adjusted accordingly. Emphasis is placed on the importance of filing Form 37 to give PAW the required data with which to support its requests for materials before the WPB allocation board.**

CURRENTLY, more than 500,000 tons of material are being consumed in petroleum operations each calendar quarter. During each 90-day period, the equivalent of 250 trainloads of equipment, machinery, and supplies is moving from the producers of material and the manufacturers of machinery and equipment into the hands of the petroleum industry for use in production, transportation, natural gasoline, refining, or distribution operations. Three full trainloads each calendar day, of a multitude of items of material for petroleum industry use, is not a small quantity of material. The largest single item is oil-country tubular goods —casing, tubing, and drill pipe. During the present quarter, more than 230,000 tons of oil-country tubular goods are being produced by the pipe mills for domestic use. This amount does not include line pipe and standard pipe required for gathering or flow lines or for the transportation or handling of petroleum and its products.

During the first quarter of 1944, about 60,000 tons of carbon steel, 30,000 tons of alloy steel, and sizable quantities of most forms and shapes of copper and aluminum will be acquired and consumed by petroleum-equipment manufacturers in producing drilling machinery and the other manufactured items of equipment required primarily for production operations. When we take into consideration the fact that the equipment manufacturers have been producing equipment for a program which has been accelerating at an unpredictable rate and one which will continue to accelerate for an unestimable period of time, we must agree that these manufacturers are to be complimented for the job they have been doing, rather than censured for the job they have not been doing. Particularly is this true when we realize that there is a lead time of 6 months or more in the manufacture of the majority of items of production equipment.

Half a year or more must elapse between the day an order is placed for raw material from which equipment is manufactured and the day the equipment is available for your use. In the meantime, the demand for material has increased at a rate which no one could predict.

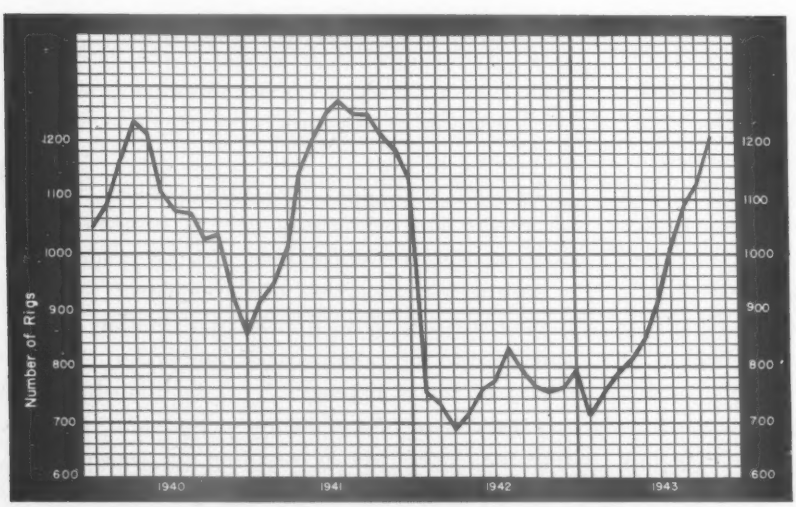
January 1 of this year, 713 rotary rigs were in operation. During July this number crossed the 1,000 mark, while currently nearly 1,350 rotary rigs are in operation. This number compares with 1,280 last month. The increase in the number of rigs other than rotary has been at a rate almost as great as that of the rotary rigs themselves. The manufactured items of material being acquired by production operators, when 1,350 rotary rigs are operating, were raw materials last June, when slightly more than 900 rotary rigs were in operation.

### Corrective Steps Taken

There have been and there will continue to be bottlenecks to interfere with production operations. Rock bits and tool joints are items which should be so classed at this time. The manufacturers of these items are well aware of the situation and are rapidly increasing their production, not only to fill current orders but to reduce the 6-month backlog of orders which are now booked by all tool-joint manufacturers. The continued energetic cooperation of these manufacturers should, to a reasonable extent, bring the supply of these items into balance with the demand during the first quarter of the year.

PAW is now making a minor amendment to Order P-98-b to eliminate the requirement of assigning preference ratings for the purchase of rock bits and core bits. This change will eliminate considerable paper work and avoid a great deal of unnecessary confusion.

In an effort to assist in keeping the supply of material in balance with demand, PAW recently distributed Form 37 to determine the approximate 1944 needs of the petroleum industry for rotary drilling machinery, including




*Showing rising trend of active rotary rigs as reported by PAW from Data by Hughes Tool Co.*

*PAW director of materials.

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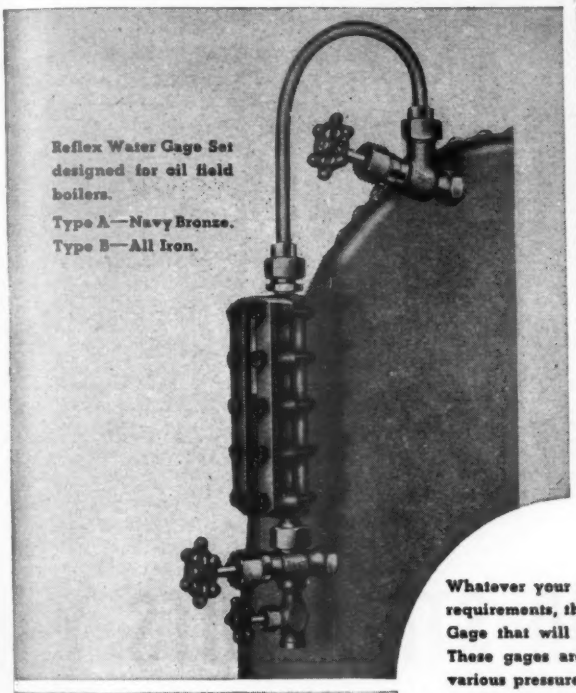

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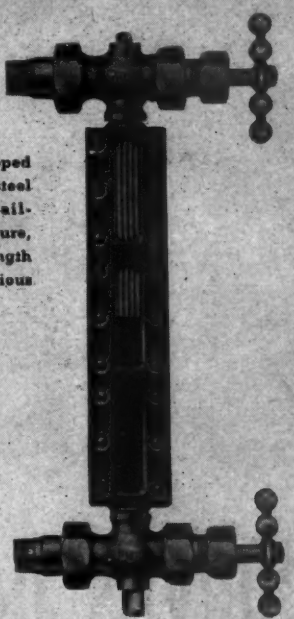

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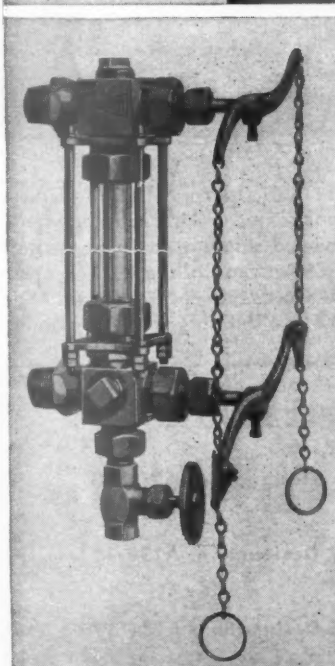
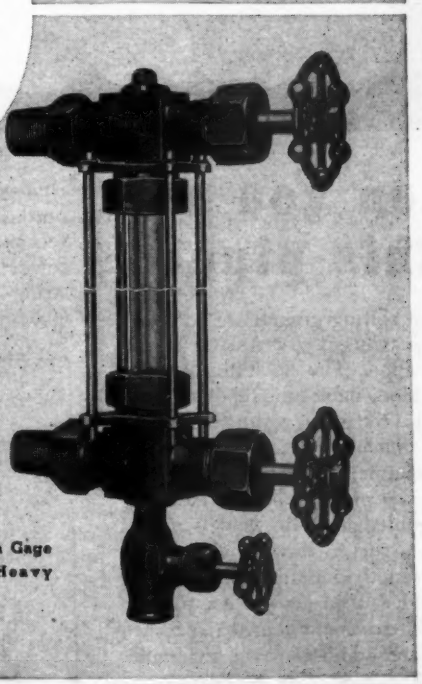


**Navy Type Gage**
**Extra Heavy Bronze**



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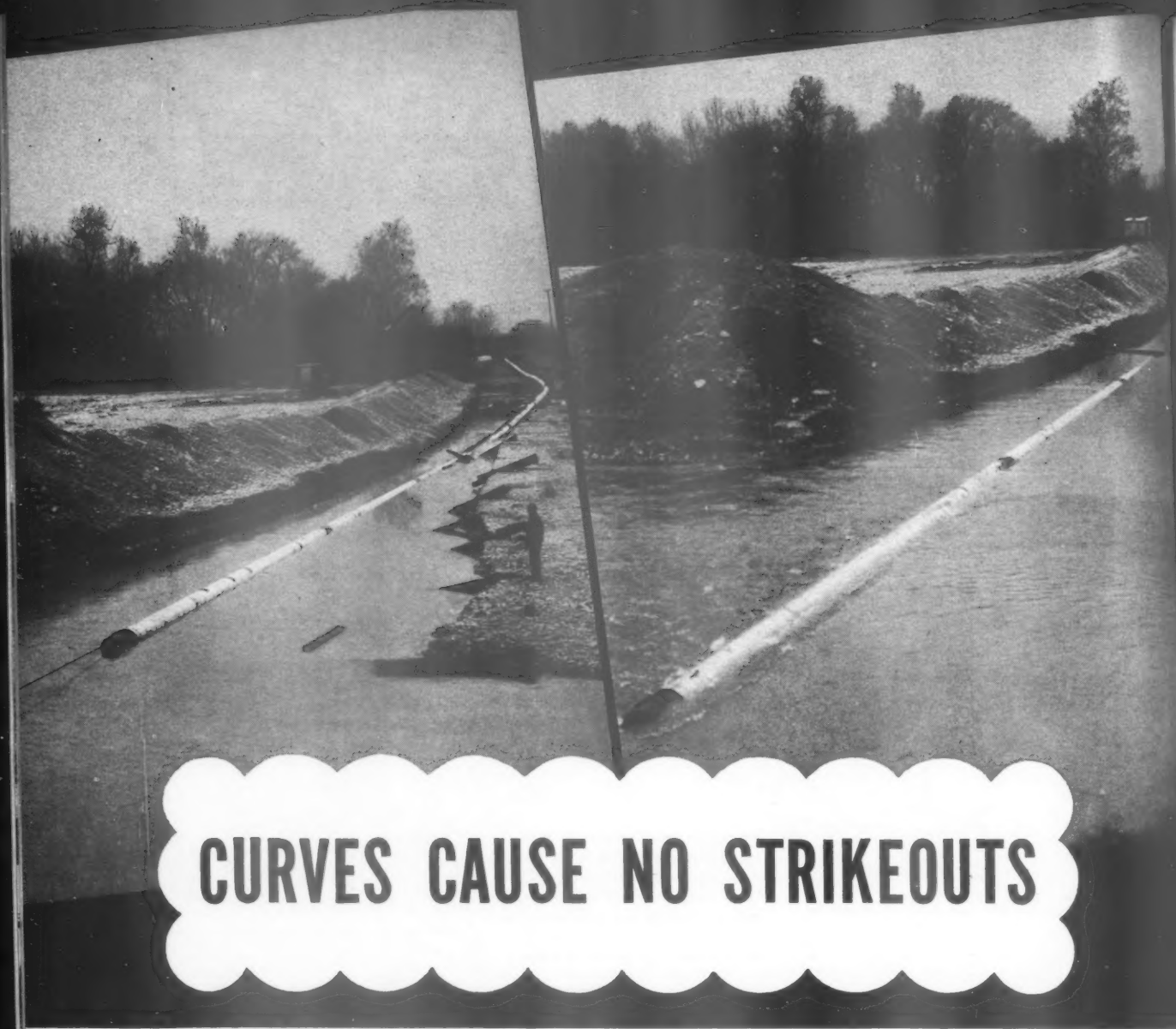

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complete new steam and power rigs and major component items for rigs which are now in operation or are stacked and will be placed in operation during next year. The replies being received indicate that production operators are doing a splendid job of estimating next year's requirements for rotary drilling machinery. PAW desires to receive an estimate from each production operator or drilling contractor who owns a rotary rig which is in operation or which is stacked and will be placed in operation during 1944. It is intended that Form 37 reach all such petroleum operators and rotary-drilling contractors.

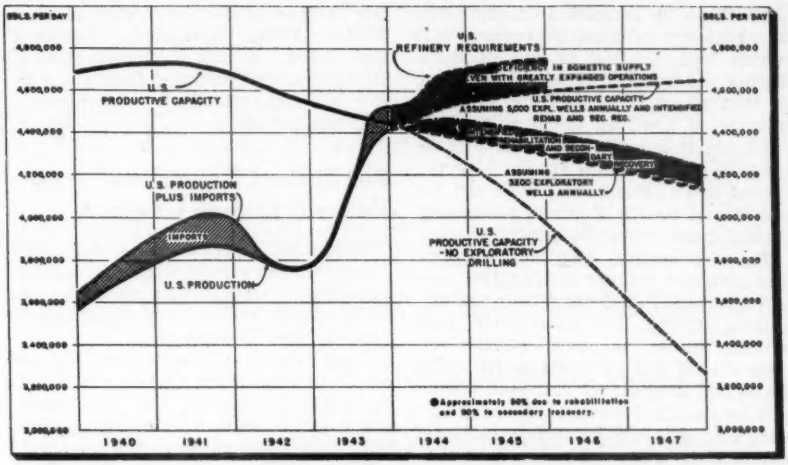
The contents of individual reports will be kept confidential. After the reports are tabulated, however, it is planned that the composite information be made available to the manufacturers of all components of rotary drilling rigs to assist them in providing a program which will, during 1944, provide a supply of equipment paralleling the petroleum industry's estimated needs.

### Engines and Parts Scarce

New internal-combustion engines and repair parts for old engines continue as bottleneck items. Military demands for these items have increased rather than decreased. As long as this condition exists, and petroleum operations continue to increase, we must anticipate bottlenecks of this kind. Fortunately, the petroleum industry is now receiving the full cooperation of most internal-combustion-engine distributors and manufacturers in increasing the supply of new engines and repair parts. This program is receiving the support of the military and the backing of the interested and affected WPB groups.

A decreasing number of inquiries and complaints are being received from the oil-field supply companies. This indicates that recent procedures are providing the supply companies with a flow of shelf items which is beginning to parallel the demand for these items. As stated during earlier occasions, there is no reason in the over-all picture why the oil-field supply companies cannot obtain sufficient materials to meet petroleum needs. Here again there will be an occasional bottleneck item, but the supply companies may depend on the WPB Petroleum Supplies Section and the WPB Industry Division for assistance in unstopping these.

We may anticipate a 1944 demand for new trucks and repair parts for existing equipment which will exceed the supply of these items. The production of repair parts is being rapidly increased. However, a few months will be required for the new production to reach the hands of dealers and distributors. In the meantime, present practices must be continued




*The PAW projection of refinery requirements against domestic supply under variously assumed conditions of development*

and equipment patched up and retained in service. The well-recognized ingenuity of the petroleum industry in operating under difficulties will carry it across this hurdle, just as many other material-shortage hurdles have been crossed.

The civilian stockpiles of new trucks which were established during 1941 are being rapidly depleted. In fact, the bottoms of these stockpile barrels will soon be reached. It is probable that these will be scraped before any new equipment can be produced. As you know, a 1944 truck production program has been authorized. It is understood that under this program approximately the same number of medium-heavy and heavy trucks will be produced during the next year for civilian use as were so produced during normal years. It is planned, however, that a comparatively small number of light and medium trucks will be produced. The weighted average of all trucks to be produced for civilian use during 1944 will be approximately 15 per cent of normal peacetime production.

Considerable disturbance has recently been caused by the rapidly decreasing supply of crude rubber.

In cooperation with technicians of the Office of the Rubber Director, many equipment manufacturers, who were convinced that synthetic rubber could not be adapted for their use, are now using synthetic rubber and find not only that it is a good substitute but that actually their success with synthetic rubber has been greater than with crude rubber. You have read recent oil-trade magazine advertisements which support this statement.

Between now and the day this group reassembles, PAW will have made advance second quarter 1944 allotments of controlled materials for petroleum operations. Your concern primarily involves requirements for production operations, particularly oil-country tubular goods. With respect to these requirements, a remark or two will be made. The pipe mills producing casing, tubing, and drill pipe have booked orders totaling slightly more than 240,000 tons for the first quarter delivery to domestic operators. The difference between this amount and their total productive capacity of oil-country tubular goods during the first quarter is approximately equal to that portion of first quarter production requirements for which delivery orders have not yet been placed. Mill and field stocks will be maintained to make material available for wildcat operations and for those operators, particularly the smaller ones, who are not always able to anticipate their requirements and place orders as far in advance as the majority of orders are now being placed and for the duration must be placed.

### Tubular Supply in Balance

Supply of and demand for oil-country tubular goods are now rather well in balance. Future requirements cannot be accurately determined until the domestic and foreign drilling programs have leveled off to establish average needs for oil-country tubular goods.

Second quarter 1944 PAW-35 applications for controlled materials for production operations are being processed in the PAW district offices in the order they are received.

Based on these premises, the applications of those operators who will require less than 500 tons of carbon steel or less than 300 tons of alloy steel be processed on the basis of 100 per cent of the amounts for which applications are filed for materials required for authorized operations. Based on these same premises, it is planned that the applications of all operators requiring amounts greater

than these be processed on the basis of whichever amount is greater—that which was allotted to the operator during the fourth quarter of this year or that which is allotted for the first quarter of 1944. In using this yardstick, fourth quarter 1943 or first quarter 1944 supplemental applications received after December 8 will not be considered by PAW when processing second quarter applications.

Those operators who will require less material for use during the second quarter of 1944 than they are requiring during this quarter or will require during the first quarter of 1944, should file applications for only the actual amount of material which will be required for use. Those operators who will require during the second quarter more material than the maximum amount allotted prior to December 8 for fourth quarter 1943 or first quarter 1944 acquisition must accompany their applications with justification for the additional material. Each operator may anticipate, however, that the advance second quarter allotment will not be for an amount greater than the larger of the two allotments — that of the fourth quarter of 1943 or the first quarter of 1944.

## Supply Problem Results in Committee Readjustments

WASHINGTON, D. C.—District offices of Petroleum Administration for War have been directed to readjust their activities and to change the makeup of district and industry committees so as to divide supply between marketing and transportation. In effect this will eliminate the supply and distribution committee by replacing the three committees with two new ones, one to be called marketing and distribution, and the other transporation and supply.

PAW officials said the transportation committee will take over the problem of getting supplies to terminals, and the marketing committee will handle distribution points on down the line.

The same consolidation will take place in the regional offices and at national headquarters here. Final decision and clarification of important details are still to be determined before the new plan actually goes into effect. The consolidation is considered as recognition that the new No. 1 problem of supply replaces the battle over transportation and distribution.

PAW pointed out that this new problem is one of getting sufficient petroleum supplies to meet requirements and equitably distributing the supplies that are available throughout the country to each type of consumer.

Personnel changes, if any, have not been determined, PAW said, but no reason was seen for any change in the division directors' positions, now held by Walter Hochuli in marketing and George Wilson in transportation. Howard Cotter resigned from the supply division last month, leaving that position vacant.

## Bill Signed Extending Federal Leases 1 Year

WASHINGTON, D. C. — President Roosevelt has signed a bill extending for another year certain oil leases on public lands which otherwise would have expired December 31.

The extension applies to 5-year leases in areas which were classified as nonproductive at the time they were made but where discoveries have since been made in the area but not on the leases in question. The new law gives the lessees another year to make discoveries.

## Maritime Commission Cancels 48 Oil Tankers

WASHINGTON, D. C.—Cancellation of a contract calling for the construction of 48 tankers and approval of the award of a contract to build 27 Victory ships by the Kaiser Co., Inc., of Vancouver, Wash., was announced today by the Maritime Commission.

The change from tankers to Victory ships under contract to the Kaiser yard is in keeping with the request of the Joint Chiefs of Staff for additional tonnage of the type to be obtained from Victory ships and conversions which can be effected thereon. To supply this type of ship in larger number, the commission has been asked to curtail the 1944 tanker construction program.

# DEATHS

**Perry A. Hoefer,** 71, oil operator and manufacturer of Tulsa and Ponca City, Okla., died December 25 in a Ponca City hospital. He was president of Foster-Hoefer Corp. and Hancock Manufacturing Co., both of Tulsa, and Hoefer Royalty Co., Ponca City.

**Charles F. Stevenson,** 64, vice president of South Penn Oil Co., died December 20 in Bradford, Pa. Stevenson's service with South Penn began in 1903 as a field worker. He became superintendent of the Bradford district, and in 1929 he was transferred to Parkersburg, W. Va., as general superintendent of the production department. Two years later he was returned to Bradford as general superintendent of Pennsylvania production. He was elected a director in 1932 and vice president in 1938.

**Ora McKenzie,** 55, and **Millard Fyffe,** 38, both of Keaton, Ky., were killed December 21 in an explosion of natural gas near a repressuring plant of Ashland Oil & Refining Co. McKenzie was a mechanic-welder and Fyffe a tool dresser.

**Paul H. Scholton,** 53, died December 23 at his home in Grand Rapids, Mich. Scholton was president of Regal Dutch Petroleum Co., Muskegon, Mich.; president and general manager of Holland Oil Transport Co., Holland, Mich.; president of Commonwealth Pipeline Co., Holland; vice president of Old Dutch Refinery Co., Muskegon. He also was active in management of Muskegon Development Co. and Muskegon Oil Corp.

**Franz Williamson,** 81, a retired oil driller, died December 24 in Wichita, Kans.

**Frank S. Reitzel,** 70, controller and assistant to the president of Sun Oil Co., died December 25 at his home in Swarthmore, Pa. He was a director of Sun Shipbuilding & Dry Dock Co., Sun Oil Co., and Houdry Corp.

**Capt. Ronald K. Drydon,** 49, superintendent of No. 2 plant of Imperial Oil, Ltd., at Sarnia, Ont., died recently at Woodstock, Ont. He was a veteran of the first World War, aided in establishing the Imperial refinery at Norman Wells, and for 2 years was in charge of operations at Port Jerome refinery, in France.

**Alex Vallance,** 56, mechanical engineer for Reed Roller Bit Co., Houston, Tex., died in that city December 19. Vallance graduated at Ohio State University and taught there, later becoming an instructor at Georgia School of Technology. He then went to University of Texas, where he was an instructor in mechanical engineering for 15 years.

**G. S. Beary,** 80, independent oil and gas operator in Venango and Clarion counties, Pennsylvania, died December 19 in Oil City, Pa. He was one of the founders of First National Bank, Fryburg, Pa.; for years was a director or Farmers Mutual Fire Insurance Co., Marble, Pa., and had important lumber and farming interests.

**William A. Wright,** 66, retired oilfield worker of Dallas City, Pa., died in Bradford, Pa., Hospital December 20. A military funeral was conducted by the Bradford post of Veterans of Foreign Wars.

**James W. Sims,** 57, for the past 25 years chief engineer of tankers of Gulf Oil Corp., died December 18 at his home in Midland Beach, Staten Island, N. Y.

**John H. Turner,** 76, retired pipeline contractor, died December 25 at his home in Dallas, Tex.

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Signal light being lit during a gravity-meter survey, Lake Maracaibo, Venezuela

*Drilling rig at Solano, Ecuador, on Daule River bank*

*Agua Blanca field, Argentina*

# Foreign Developments Depend on

***by H. Stanley Norman and J. P. O'Donnell***

FORMATION of a concrete American foreign-petroleum policy is by all odds the most significant international development in prospect for 1944. On this issue hinges a galaxy of questions, including rates of production, refinery construction and establishment of distribution facilities which will be important in postwar marketing operations as well as in prosecution of European and Pacific military strategy.

A preliminary commitment by the United States in which the Government would have become a direct participating owner in middle eastern petroleum reserves currently under domination of American nationals has been withdrawn. There are no assurances, however, that negotiations with the private companies have been permanently ruptured.

The American foreign-oil policy may take any of these three directions: (1) Stronger diplomatic protection for its private national companies operating abroad; (2) full reliance on international law, much along the lines of prewar relations; or (3) direct government participation as a partner with American national companies through a federal oil agency, such as Petroleum Reserve Corp.

Sentiment in the American petroleum industry, including companies having large stakes in foreign oil properties, is predominantly in favor of much stronger diplomatic protection for United States nationals with control of operations left exclusively in private corporations and individuals.

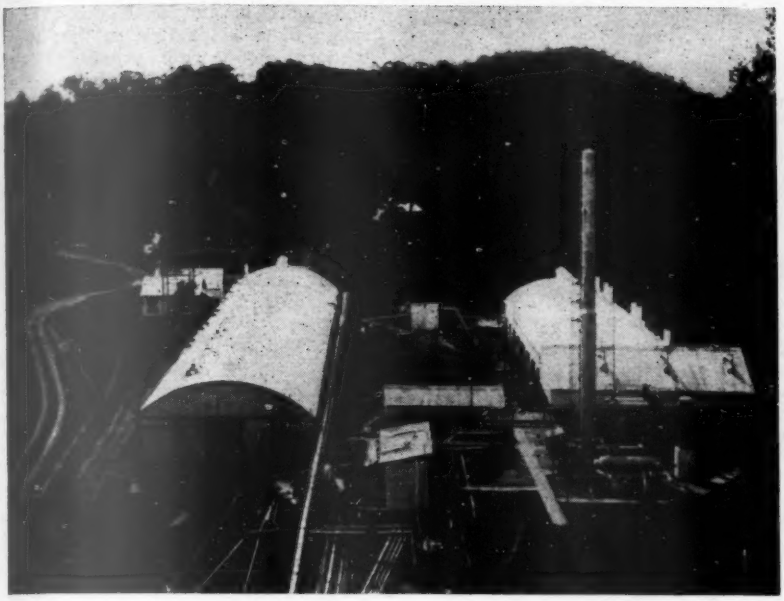
Regardless of which course United States foreign-oil policy takes, the conclusion is inescapable from every possible analysis of productive capacity and supply requirements that much greater reliance will be placed on oil reserves of the Middle East and South America over the next 12 months.

### South American Plans

Programs are now well advanced for the production of 1,250,000 bbl. daily from exporting countries in the northern part of South America and Trinidad by the middle of 1944. Approximately 1,000,000 bbl. daily will come from Venezuela; 85,000 bbl. daily from Colombia and 165,000 bbl. daily from Peru, Ecuador and Trinidad. Plans call for the most active exploitation drilling program in South American oil history in order to fulfill the production objectives. Estimates call for 450 to 500 new wells in Venezuela, probably 150 in Colombia and at least that many more in the other areas combined.

In order to make the maximum use of available refining facilities, mostly in the Netherlands East Indies and the United States, the increased demand from Venezuela will fall chiefly on the light-oil fields in the eastern part of the country. To double or triple current production from eastern Venezuelan fields will require expansion of existing pipe-line and shipping facilities, in addition to the new drilling. Eastern Venezuela has three major transportation arteries consisting of the Mene Grande Oil Co. and Standard Oil Co. of Venezuela 16-in. Oficina line; Venezuelan Petroleum Co.'s 12-in. line from Santa Barbara to the north coast and Standard of Venezuela's Jusepin and Quiriquire lines terminating on the San Juan River, leading to the Gulf of Para. Attainment of Venezuelan production goals, if as much as 50 per cent of the daily production of 1,000,000 bbl. is assigned the light-oil fields, will require that pipe-line facilities be approximately doubled, either by additional lines or by looping those now in service and by installation of greater pumping capacity.

A transportation problem also circumscribes full utilization of Colombian resources. For example, Shell Oil Co.'s new Casabe field, across the Magdalena River from Tropical Oil



*San Pedro compressor and gasoline plant in northern Salta, Argentina*

# on Clarified U. S. Policy

Co.'s De Mares concession, produces a lower gravity crude than is currently withdrawn from the Tropical property. The conditions present a question of whether to commingle the two types of crude for the sake of additional volume or to maintain inherent advantages of the lighter oil in manufacturing operations to the exclusion of Casabe crude.

### Production Already Rising

Heavier withdrawals of crude oil from Venezuela, Colombia and Mexico started during the last 4 months of this year although the increases registered through November were modest compared to the production goals set for next year. Mexico's production, for instance, increased to 110,300 bbl. daily in October and stood at 108,300 bbl. daily in November compared with less than 75,000 bbl. a day for the last half of 1942. Venezuelan production is approximately 650,000 bbl. daily compared to a low mark of 400,500 bbl. a day during the first half of 1943.

At least 50, possibly 75, new wells will be drilled next year in Mexico compared to about 35 in the closing 12 months. Part of the intensified exploration and exploitation program will be reflected in higher exports but the internal demand for crude oil will rise at the end of 1944 to satisfy requirements of a new $12,000,000 aviation-gasoline refinery authorized at Mexico City. Included in Mexico's program are expansion of pipe-line capacity from the Poza Rica field to Mexico City and possibly a consolidation of natural-gasoline plants in the Tampico region.

Steps to make additional use of the oil from Iran, Iraq, Bahrein Island, Saudi Arabia and Kuwait antedated the recent visit to that area of the group of United States senators which focused public attention on it for the first time. These steps included expansion of facilities at the Anglo-Iranian Oil Co., Ltd., refinery at Abadan and the Bahrein Petroleum Co. refinery on Bahrein Island. Facilities to increase the production of 100-octane aviation gasoline were installed at the former while the crude capacity of the Bahrein refinery was increased.

The main factors dictating dependence on the Western Hemisphere for military oil supplies have been its proximity to the battlefronts and its possession of the world's best refining equipment. Because of the tanker shortage which began to be felt in 1940, it became imperative to employ the shortest routes possible. At that time there was some minor criticism directed at the British for still using tankers to transport oil from Abadan to the United Kingdom when Western Hemisphere sources were so much closer. The Mediterranean was closed to Allied shipping and London was 11,290 nautical miles from Abadan as compared to 4,120 miles from Curacao and 5,022 miles from United States Gulf ports. The basis of the criticism then was the direct opposite of what it is today.

### Tankers Determined Operations

Since the tanker shortage made it imperative to use available vessels to their fullest advantage by employing the shortest possible routes, development of oil resources so far during the war has been forced into a prescribed range. This country had the only refining capacity capable of meeting war requirements and therefore the use of domestic crude as fully as possible was dictated. Three years ago it was generally believed that this country could supply all war requirements from the surplus that then existed.

From May 1943 on, the availability of tankers has improved and, with the submarine menace virtually eliminated, it has accelerated markedly in recent months. This has made it possible to resort to other crude sources and the increases in Venezuela and Colombian production since

*Dykstra's dike in the Casabe concession, Magdalena River district of Colombia*

*Central camp school building in northern Argentina. Education of employes' children is a responsibility long assumed by oil companies operating in foreign countries*

the middle of the year show that this has been done.

The improvement in the tanker situation and the opening of the Mediterranean as a result of the African, Sicilian and Italian victories is now making it possible to utilize the middle eastern oil. Early this year the northern leg of the Iraq pipe line which has its terminus at Tripoli, Syria, was reopened and this line since, according to reports, has been carrying its capacity of 80,000 bbl. daily. Personnel and equipment to increase production elsewhere in the area are now in transit.

Utilization of oil from the Persian Gulf is controlled by two things, transportation capacity and refining facilities. Practically all of the fields have potentials well in excess of available pipe-line outlets. Some have no outlets at all and their combined potential is far in excess of immediately available refining capacity. Therefore, maximum utilization of middle eastern oil requires not only the construction of considerable pipeline mileage but also either the addition of refining capacity in the area or the transportation of the crude oil thousands of miles to existing refineries.

Anglo-Iranian Oil Co., Ltd.'s refinery at Abadan has a capacity of approximately 300,000 bbl. daily. Reports on production show that Iranian output this year has been in the neighborhood of 200,000 bbl. a day, meaning that the refinery, which is supplied entirely by fields within the country, has been operating at about 65 per cent of capacity. This is probably attributable to inability to transport capacity output from Abadan and to the lack of a substantial amount of high-octane gasoline refining capacity.

The Abadan refinery receives its crude oil principally from the Haft-Kel and Masjid-i-Sulaiman fields, 100 and 130 miles, respectively, northeast of Abadan. It is also connected by a 12-in. line with the Gach Saran field, 125 miles southeast of Haft Kel. Gach Saran was discovered in 1937 and before development was interrupted by the war, had a proven extent of 100 sq. miles. It is even greater in area than the older fields of Haft Kel, with an area of 40 sq. miles, and Masjid-i-Sulaiman, 56 sq. miles. Two of the initial Gach Saran wells were rated at 33,000 bbl. a day with a pressure in excess of 800 lb. per sq. in.

### Big Potentials Indicated

The area of these fields, the initial production of the wells and the pressures indicate tremendous potentials. Other production has been developed at Agha Jari, 55 miles southeast of Haft Kel and 70 miles northwest of Gach Saran, and at White Oil Springs between Haft Kel and Masjid-i-Sulaiman. In addition, Anglo-Iranian, through a subsidiary, Kermanshah Petroleum Co., Ltd., operates the Naft-i-Shah field on the Iran-Iraq border. Production from this field is processed at the small Kermanshah refinery, 145 miles to the east, which supplies local needs. The oil is transported through a 3-in. line.

Only one other development in the Persian Gulf area includes both producing and refining facilities of consequence. This is Bahrein Island, where Bahrein Petroleum Co., Ltd. (Standard Oil Co. of California and Texas Co.) has a 100,000-acre concession and at the island's capital, Manama, operates the refinery now being enlarged. Bahrein is somewhat typical of middle eastern fields. Production was discovered only 11 years ago and most of the development has taken place since 1934 so that most modern engineering practices have been employed. As in the case of many foreign fields, only one company is involved. There is no race for production. In the original development, Bahrein wells were spaced 3,000 ft. apart, one well on each 180 acres.

California-Arabian Standard Oil Co. (also Standard of California and Texas Co.) has developed production at several points in Saudi Arabia where it has a concession covering 160,000,000 acres. The only commercial production is from the Dammam field where the main producing horizon was discovered only 5 years ago. Some 30 wells have been drilled. A 43-mile, 10-in. pipe line carries this production to the port of Ras Tanura where the company has a small refinery and marine terminal. Additional production has been developed at Abu Hadriya, 100 miles northwest, and Ma'agala, 120 miles west of Dammam. It was this vast concession in which Petroleum Reserves Corp. was interested before negotiations recently were suspended.

Production has also been developed on Qatar Peninsula which juts out into the Persian Gulf south of Dammam. The concession in this area is held by Petroleum Development Co., Ltd., which also holds concessions in many other areas of the Middle East.

The fourth proven source of oil in the Persian Gulf area is Kuwait, where the Kuwait Oil Co. (Anglo-Iranian and Gulf Oil Corp.) has the oil rights on all of the 2,000 sq. miles of the Sheikdom. A field has been discovered at Burghan in the southern part of the country and the reserves, though the estimate is admittedly inconclusive, are believed to run into several billions of barrels. The first Kuwait test, drilled at Bahrah, was a failure but substantial potential shallow production, around 3,700 ft., was developed later at Burghan.

The Kirkuk field, operated by Iraq Petroleum Co., an associate of Petroleum Development, Ltd., is Iraq's one important producing field. Its production is rated at 80,000 bbl. daily, being limited by the capacity of the bifurcated pipe line terminating at Mediterranean ports. The Kirkuk field, 50 miles in length, is typical of the large producing areas of this region. Iraq Petroleum is owned 23.75 per cent each by Near East Development Co. (Standard Oil Co. [New Jersey] and Socony-Vacuum Oil Co., Inc.), Anglo-Iranian Oil Co., Ltd., and Compagnie Francaise des Petroles and 5 per cent by Participations & Investments (C. S. Gulbenkian). Other production is available in Iraq at Mosul where the Qaiyarah fields yield heavy oil and at Naft Kaneh, the Iraq section of the field operated in Iran by Kermanshah Petroleum.

# Sustained Productive Capacity in Venezuela to Receive Thorough Test

**Substantial expansion in withdrawals of crude oil from Venezuelan fields in the 1944 logistic plans of the United Nations is based chiefly on previously proven productive ability and reserves. However, the projected production rate of 1,000,000 bbl. daily, or more, will require the drilling of a record number of new wells, probably 400 to 500.**

VENEZUELA has come far in the past 30 years to attain its current place as one of the world's three major producing countries. Although the oil industry may be said to have begun in Venezuela back in 1878 when exploitation of shallow wells and pits was undertaken to supply a small local market, it was not until 1912 that active exploration for oil was initiated and the first major discovery, the Mene Grande field, was opened in 1914. This field is about 10 miles inland from the eastern shore of Lake Maracaibo and was the forerunner of developments which followed in rapid succession in the lake area and which have made it the country's major oil-producing locality.

Intensive search for oil carried on since 1912 has uncovered oil fields throughout the length of Venezuela and the operations have to contend with a wide range of physical conditions, both surface and subsurface, ranging from dense jungle to semi-arid land or over-water operations in water depth of 80 ft. and more, and from shallow tar-oil deposits to 10,000-ft. condensate reservoirs.

From an oil standpoint, the country now stands divided into two major areas by the Venezuelan Andes which pass south of Lake Maracaibo in a northeastward direction. To the east lies the Orinoco basin and to the west the Maracaibo-Falcon basin. The general features and problems of these two regions differ considerably.

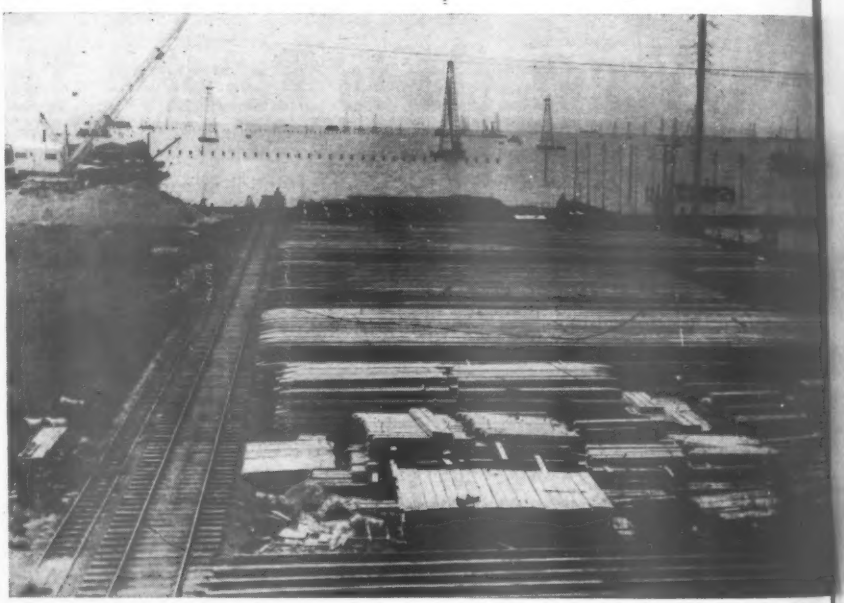
### Eastern Venezuela

In the extreme eastern part of the country, in the State of Monagas, the principal shipping fields are Quiriquire, Jusepin, Santa Barbara (Mulata) and Temblador. The first three are on a northeast-southwest trend in northern Monagas with Quiriquire, the oldest, having been discovered in 1928, while Jusepin and Santa Bar-

*View of the power plant at Standard Oil Co. of Venezuela's Caripito refinery*

*Left: Tankers loading at Lagunillas for transporting Venezuelan crude oil to the nearby refineries on Aruba and Curacao islands*

*Below: Yard where concrete piles and caissons required at Lake Maracaibo locations are precast*



bara were brought in during 1938 and 1941, respectively. The Quiriquire field produces an oil averaging around 19 gravity A.P.I., from an average depth of about 3,000 ft. Both of the other fields produce oil of around 33 gravity from depths of 4,000 to 5,000 ft. Temblador, in the southern part of Monagas, was discovered in 1936 and produces 21-gravity oil from around 3,500 ft.

Much of northern Monagas is but sparsely populated and is marked by thick jungle country, particularly near the numerous streams, and this feature has introduced many problems in connection with the required surface development before large-scale drilling and production operations are feasible. Actual drilling problems have not been serious, however, and no unusual techniques or equipment have been employed. Rigs, all steam powered, are similar to those commonly employed in the United States for normal 5,000 to 6,000-ft. drilling. The formations are fairly soft at Quiriquire, but somewhat harder at Jusepin and Santa Barbara. Both drag and rock bits are used for drilling all but the surface hole; rate of penetration is good and bit service fairly high. There are two major oil zones in both the latter fields and dual-completion technique, with a packer between zones, is commonly employed. At Temblador, where most of the country is open prairie land except along the rivers, no serious drilling problems are found except that of proper well completion with reference to bottom water.

Most of the production from these four fields is by natural flow. Only in the Quiriquire field has some pumping been necessary to date. The major features of interest in the producing operations of these fields are the pressure maintenance by gas return at Quiriquire where part of the produced gas has been returned to the sand for several years, and the dehydrating and desalting operations at Temblador where the high salt content of the water has necessitated extensive installations for large-scale wet-oil treatment.

Oil from the Quiriquire and Jusepin fields is moved eastward by 10-in. and 8-in. pipe lines to Caripito on the San Juan River where a refinery and terminal are located through which crude oil and products go by tanker to world markets via the Gulf of Paria. The Santa Barbara field has been only recently placed on full production following completion of a 12-in. pipe line westward to Puerto La Cruz. Temblador crude goes by pipe line to a terminal at Boca de Uracoa on the Manamo River, thence by shuttle tanker to a deep-sea terminal at Guiria on the north shore of the Gulf of Paria.

In the State of Anzoategui, next west from Monagas, there has been a rapid and intensive development since the first major discovery of the area, the Oficina field, in 1937. This field, about 100 miles inland from the Caribbean Coast, was followed in succeeding years by the discovery of a number of other pools in the area, among the more important of which are San Joaquin, Leona, Santa Ana and El Roble. All of these fields have generally similar subsurface features and are marked by multiple produc-

ing sands. In some instances the sands show a range of oil gravity of from 15° to 50°, A.P.I. Not all of the heavier oil is being produced, however, and average gravity of the produced oil in the area is around 35 gravity. Producing depth ranges from around 5,000 to 10,000 ft. subsurface and the oil in some of the reservoirs is in the vapor phase.

There have been many drilling problems in this area most of which have stemmed from unusually high subsurface pressures and temperatures, the latter being as high as 275° F., in the deeper wells, coupled with hard formations and poor mud-making qualities of the strata penetrated. The drilling rigs commonly used are steam powered and employ heavy equipment, with 136-ft. derricks, four 125-hp. high-pressure boilers, two 20-in. slush pumps, 300-ton hooks, etc., being common. All equipment is unitized and skid mounted, and in developed areas, rig moves are made in around 5 hours.

The Anzoategui fields are served by a 16-in. pipe line which runs from Oficina to the coast at Puerto La Cruz, where there is a deep-sea terminal.

### Western Venezuela

While there are a number of producing fields in western Venezuela, ranging from the small Cumarebo pool on the north coast in the State of Falcon, a field in which almost complete pressure maintenance by gas return has been practiced, to fields near the Colombian border, the major reserve of the area and the feature of greatest interest from an operating standpoint is in the Bolivar coastal fields on the eastern shore of Lake Maracaibo. These fields extend along the shore of the lake for some 50 miles and large portions of the productive acreage are under water. Except in the close inshore areas, the water depth is too great to permit the use of conventional wooden piling for foundations and many unique practices have been developed to permit operations in water depths of over 80 ft. and at distances which to date have reached some 8 miles from land. The productive sand in these fields dips lakeward and current producing depth ranges from about 1,000 ft. in certain areas along the shore to 5,000 ft. in the downdip areas under the lake. Oil gravity varies from around 12° to 28° A.P.I., the lighter oil usually being found in the downdip areas.

The equipment for the first lake wells, drilled in shallow water, was supported by land-type concrete pedestals or by timber mats, and operations were identical with those on land. Production was extended into 10 or 15 ft. of water by substituting wooden piles for the pedestals, but it was soon evident that specialized foundations and equipment would have to be developed for the econnomic exploitation of deeper-water extension of the fields.

For water depth up to 60 ft., precast monolithic concrete piles were selected because they are not attacked by either the wood-eating teredos or by the very corrosive lake water, and because they could be built in any size to suit a variety of structures and foundation conditions. With the exception of such special types as sheet piles, precast piles from 12 to 24 in. square, and up to 133 ft. long are used. Extensions are occasionally cast on the piles to a total length of 145 ft.

With these piles, which are placed by a pile driver barge, the standard derrick foundation consists of two plumb and one batter or brace pile in each corner, a total of 12 piles per well. A concrete cap, cast in place on each corner, ties the three piles together and to the structural-steel derrick base, to make a rigid structure. The base is 24 ft. square with a 15-ft. cantilever overhang on one side and 10 ft. on another, and carries all loads to the corner piles. It supports the engine, draw works, rotary, landing platform, derrick and auxiliary drilling machinery. During drilling operations, the draw works, drilling engine, and engine house are placed on one of the cantilevers and a small wire line hoist and steam engine for pulling a wire-line core barrel, or for swabbing, is placed on the other. Later, when the well is put on the pump, the pumping unit is placed on one cantilever leaving the other for a cleanout hoist. The same weight of base is used for all wells within fixed depth limits. To determine the length of piles necessary, a test pile is driven at each location, and the foundation piles are cast exactly to fit the site.

### Deep-Water Practices

For water depths of more than 60 ft., a completely new type of pile had to be developed and the result was a caisson-type foundation. It consists of four concrete encased steel core composite hollow cylinders, 5 ft. or more in outside diameter and having a wall thickness of about 6 in., connected above water by welded steel-arch girders to form a rigid frame. The full length caisson is fabricated on land by joining several 15-ft. lengths, and the completed pile is then moved by barge to location where it is upended by derrick barges and set in place. The caisson piles are not driven, as are the solid piles, but are forced to the desired depth in the lake bottom by the imposition of 200 tons of dead weight in the form of concrete blocks placed on top of the pile after it has been lifted into position, filled with water, and allowed to sink of its own weight as far as it will go. The longest cylinders used so far are around 185 ft. in length and

*General view of the La Salina refinery on the shore of Lake Maracaibo*

weigh around 100 tons. The caisson foundation is similar to the older pile type only in that it uses the same derrick base supported at the four corners. Fundamentally, the two designs differ radically because the pile type depends upon brace piles for lateral strength whereas the caisson type is a true rigid frame without braces.

In drilling with either type of foundation, the power plant, pipe racks, mud pumps, and pits are mounted on a drilling barge which is anchored adjacent to the derrick foundation. The present drilling barges are 110 by 48 by 8 ft. and are equipped with three or four 125-hp. oil-field boilers, two 18 or 20-in. mud pumps, fuel compartment holding 225 bbl. of oil, mud-circulating system and pit, pipe rack, and anchor hoists. Mud, water and steam lines are connected to the rig from the barge by means of flexible connections. Auxiliary barges consist of a cementing barge, mud barge, fuel barge, and production test barges, as well as dumb barges for transporting equipment.

**Facilities Mounted on Piles**

Gathering stations, compressor plants, absorption plants, permanent boiler stations and high-tension transmission lines have all been built on the monolithic concrete-pile foundations, the deeper water caisson type not yet having been required for these units. Each foundation is designed for the equipment it is to support, and may vary from light concrete-pile caps supporting steel beams and a wood deck for gathering stations, to massive monolithic concrete decks for vibrating machinery, such as 600-hp. compressors.

All flow stations are equipped with automatic float switches which start the station-to-shore pumps when the oil reaches a height of 6 ft. above the suction and cut them off at 1 ft. above the suction. Although the tanks are capable of holding 24 ft. of oil, they are kept pumped down so that in case of a power interruption there will be ample space in the tanks to receive the production while producing wells are being closed in. The crude oil from the flow stations is received and fiscalized at four shore tank farms located at Lagunillas, La Salina, Rio Ule and Punta Gorda. The first two of these, Lagunillas and La Salina, are also lake tanker-loading terminals while Rio Ule and Punta Gorda are merely receiving and transfer points.

One of the phases of the lake operations which is considerably different from the corresponding work on land is the laying and maintenance of pipe lines in the lake. Welded lines laid in the lake to date include all the standard sizes of line pipe from 3 to 12 in., inclusive. Before any joint is ready for installation it is first treated with a coating of enamel in the pipe-treating plant on land. The treated joints are then welded together in lengths approximately 95 ft. long and sent out on the lake to a special pipe-laying barge. These barges, 110 by 40 by 7 ft., have been equipped with pipe racks and special gear for letting the welded line slide into the water at the stern as the barge is drawn ahead. As each joint is welded to the line it is allowed to slip partially into the water and a new joint is moved into position and welded onto the line. In the deepest water it is necessary to give the pipe additional support by using empty 50-gal. oil-drum buoys to prevent sharp bending of the pipe.

All gas-oil separation is done at the flow stations and in designing the lines, the problems are much the same as those encountered in the design of similar shore lines. One problem peculiar to the lake is posed by existence in the water of a small marine animal, the teredo, which eats through the protective coating exposing the pipe to the corrosive waters of the lake. In laying the lines, it is of utmost importance that they do not cross any more than is absolutely necessary, as crossings complicate the work of picking lines up for repairs or salvage. Minor leaks can sometimes be repaired by clamps placed on the lines by helmeted divers, but for any major break the line must be fished up and repaired on the barge.

To operate and maintain this complex system of over-water operations has required the installation of extensive facilities ashore where are located power plants, pile-casting yards, well-equipped marine repair and construction yards and completely equipped machine shops. A large fleet of speed boats, launches, tugs and barges of various types and sizes is, of course, a necessity since all transportation is over water.

In general, the operating problems and techniques in Venezuela, while adapted to local conditions, are essentially similar to those in other oil fields, excepting, of course, the unique conditions in Lake Maracaibo, and the equipment and practices employed are kept well abreast of developments elsewhere. Adequate technical staffs are carried by the various operating companies and studies looking to constant improvement of drilling and production practices, and the adaptation of the latest equipment designs, are commonplace.

# Pantepec's Mulata Field Active

PANTEPEC Oil Co. of Venezuela, C. A., is a Venezuela corporation that was organized in 1924 and has a total capitalization of Bs. 12,000,000 represented by 3,000,000 shares.

On February 20, 1943, Pantepec and Standard Oil Co. of Venezuela (now Creole Petroleum Corp.) concluded an agreement which replaced the drilling contract of March 14, 1934. The concessions in the proven properties consisting of El Roble, Amana (Mulata) and the TR and TR-N concessions in eastern Venezuela continue to be operated by Creole for joint account on a 50-50 basis. The remaining concessions under the previous contract were divided equally between parties.

Creole assumed the obligation to pay Pantepec for a minimum of 6,000 gross barrels of oil a day, less royalty, over a period of 3 years beginning on March 1, 1943. During the 3-year period, Creole is obligated to increase the movement from the jointly owned properties proportionately when its own production in eastern Venezuela is over 60,000 gross barrels a day, but Creole is not obligated to pay for or produce Pantepec's share of oil in excess of an average of 10,000 gross barrels per day during the 3-year period ending February 28, 1946.

Pantepec now has an undivided 50 per cent interest with Creole in 74,070 acres in the proven properties and also has 100 per cent interest in 326,117 acres of undeveloped properties, also in eastern Venezuela.

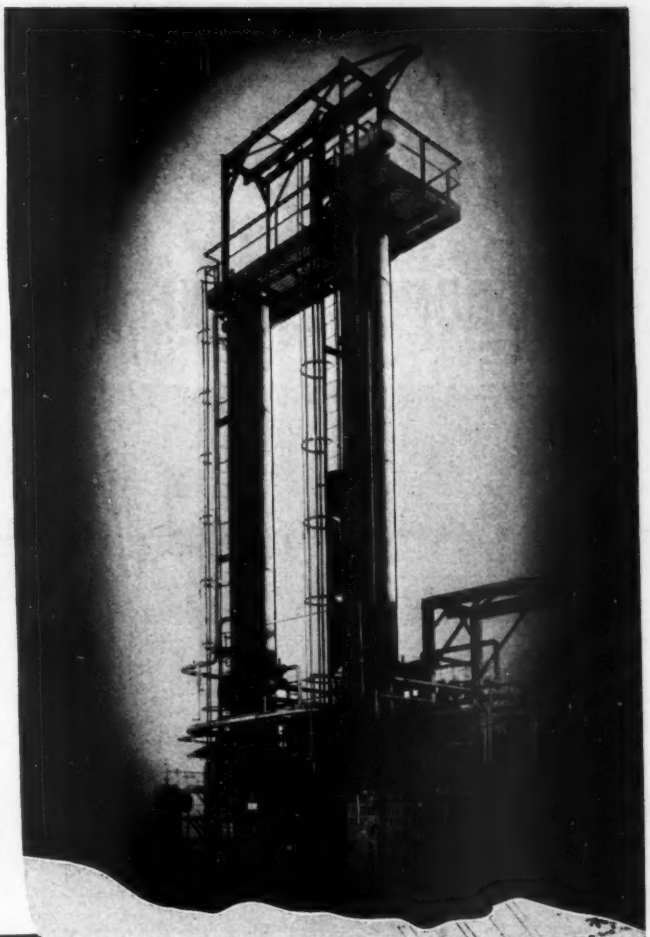
There now are 10 producing oil wells on the Roble concession and it is estimated that the gross production for joint interest from this field for 1943 will amount to approximately 1,700,000 bbl. This oil ranges between 43° and 47° A.P.I. It is estimated that during 1944 daily gross production from this field for joint interest will be 7,000 bbl.

There are eight wells in the TR and TR-N field. Production is nominal.

Considerable drilling has taken place in the Mulata field in the Amana concession. At May 1, 1942, there were five oil wells having an estimated gross initial daily capacity of 1,700 bbl. for joint account, before royalty deduction. At December 31, 1943, there were approximately 40 producing oil wells in this field and the gross daily production for joint interest was around 15,000 bbl. The oil ranges between 33° and 35° A.P.I.

According to the consolidated program for the Caribbean area for 1934 prepared by the Petroleum Administration for War, it is contemplated that 51 wells will be drilled in the Mulata field. This drilling would increase the gross production for joint interest from the Mulata field to a minimum of 35,000 bbl. per day by January 1945.

# Design for *Better* Gas Purification!

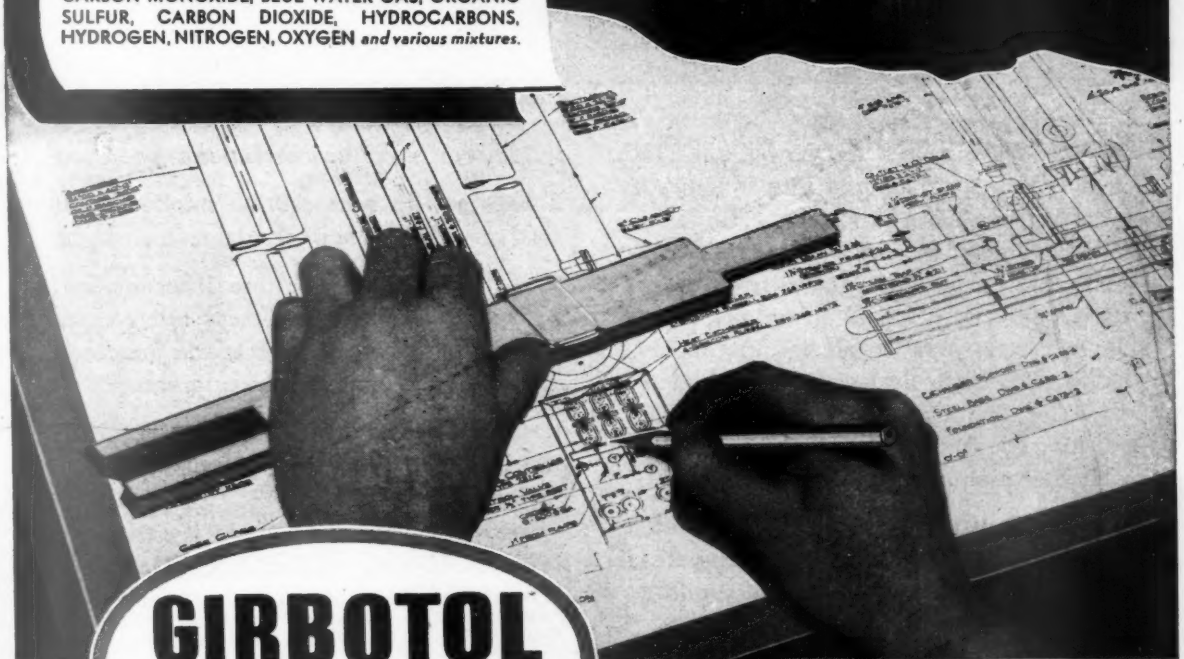


## GIRBOTOL PROCESS APPLICATIONS IN REFINERY AND NATURAL GAS FIELDS

***Purification of refinery and casinghead gas for:*** **Feed stock of polymerization and alkylation plants. Recovery of sweet propane and butane fractions. Reduction of corrosion in lines and processing equipment. Synthesis of iso-octane, hydrogen, industrial chemicals.** ***Purification of natural gas for:*** **Industrial and domestic consumption. Preventing diffusion of sour gas into sweet gas sands. Repressuring sweet oil fields. Manufacture of carbon black.** ***Purification and dehydration of natural gas to prevent corrosion and hydrate formation in transmission lines and equipment.***

## OTHER GIRDLER PROCESSES

**Processes for *Production, Purification, Separation, Reforming or Dehydration of* HYDROGEN SULFIDE, CARBON MONOXIDE, BLUE WATER GAS, ORGANIC SULFUR, CARBON DIOXIDE, HYDROCARBONS, HYDROGEN, NITROGEN, OXYGEN *and various mixtures.***



# GIRBOTOL

*Gas Purification Process*

GIRBOTOL process costs much less to install. No expensive catalyst or frequent replenishing. Purifies and dehydrates simultaneously. Safe to use on hi-pressure and hi-sulphur content lines. Removes traces of $H_2S$ as well as bulk.

THE GIRDLER CORPORATION, Inc., LOUISVILLE, KY.

GUARD *and extend* the power built into your International Power Units by observing the most important wartime conservation measure of all—PROPER ENGINE CARE. And the man who stands ready to give you a wealth of practical pointers on proper engine care is your friend, the International Industrial Power dealer. Call on him for valuable help on getting maximum efficiency and long life from your engines.

Here are some suggestions he offers:

**1. Care, Operation, Adjustment.** Watch everything . . . fuel, lubrication, cooling. Read and study your operator's manual carefully, for definite, helpful conservation suggestions.

**2. Let's all be conservation minded.** Take good care of your engines and treat them right.

**3. Parts.** Insist on genuine International Parts when replacement parts are needed. They fit better, wear longer, and are made from the same molds as the originals.

**4. Ask the dealer for help and advice** about priorities, limitation orders, used equipment, equipment exchange, etc.

**INTERNATIONAL HARVESTER COMPANY**
180 North Michigan Avenue Chicago 1, Illinois

★ ★ ★ ★ *Buy War Bonds . . . Save and Serve America* ★ ★ ★ ★

INTERNATIONAL POWER

# War Demand Stimulates World Production to All-Time High Level

***by I. P. O'Donnell***

UNDER the stimulus of war demand which affected virtually every oil-producing area, the world production of crude oil rose to an all-time high this year. World production for 1943 is estimated at approximately 2,260,000,000 bbl. in contrast to an estimated 2,050,000,000 bbl. in 1942 and the previous all-time high of 2,220,000,000 bbl. which were produced in 1941.

Construction of needed transportation facilities was the major factor contributing to the increase this year for they enabled the oil industry to meet all the requirements of the armed forces of the United Nations as well as essential civilian needs. Lack of tankers to accommodate the production of exporting countries and the lack of pipe lines to supply internal United States requirements caused the slump in 1942. The construction of scores of tankers and the building of the big-inch and supplementary pipe lines in this country made it possible to reverse the downward trend of 1942 and begin an upward swing that is expected to result in another large gain in 1944.

The principal production increases this year have been in the United States, up an estimated 123,355,000 bbl.; Venezuela, 32,500,000 bbl.; Soviet Russia, 23,250,000 bbl., and Iraq, 12,775,000 bbl. In each instance improved transportation was the most important factor in the increase.

New pipe lines contributing to improved internal distribution and additions to the tanker fleet which made it possible to export larger quantities of war products resulted in the United States increase. Freeing of the sea lanes of Axis submarines accounted for the gain in Venezuela where a substantially greater improvement is envisioned for 1944. Russia's oil transportation system was improved by expelling the Germans from the Caucasus and Stalingrad. At Stalingrad the Germans could control the traffic on the Volga, Russia's main artery of internal distribution. At the peak of their invasion of the Caucasus, the Nazis were on the edge of the Grozny area and controlled the pipe lines delivering oil from the eastern Caucasus to the west and to the Ukraine.

### Iraq at Prewar Pace

Iraq production rose as a result of the opening of the northern leg of the pipe line to the Mediterranean early in the year.

North America, through the large gain in United States production, continued to lead by a large margin among the continents. United States production offset slight declines in Canada and Mexico. The Canadian drop was due to the decline in Turner Valley production which persisted through most of 1943. Mexico continued to suffer from the lack of vital export markets, a condition which apparently was being corrected in the latter part of the year.

The United States gain represented 60 per cent of the world increase. It is significant that this large increase came from the country whose reserve position in relation to domestic demand is the weakest of any of the major producing countries.

South America's increase appeared to be generally distributed with the most substantial gains attributed to Venezuela and Colombia which had been the most severely curtailed. Colombia's production has been on the increase since May and by September it was 8½ times the low point of January. Colombia's production in the near future may exceed the all-time record average of 83,800 bbl. daily, established in February 1942. Venezuela's output has been on the increase since the middle of the year and was expected to show a 75 per cent gain in the daily average by De-

*(Continued on page 103)*

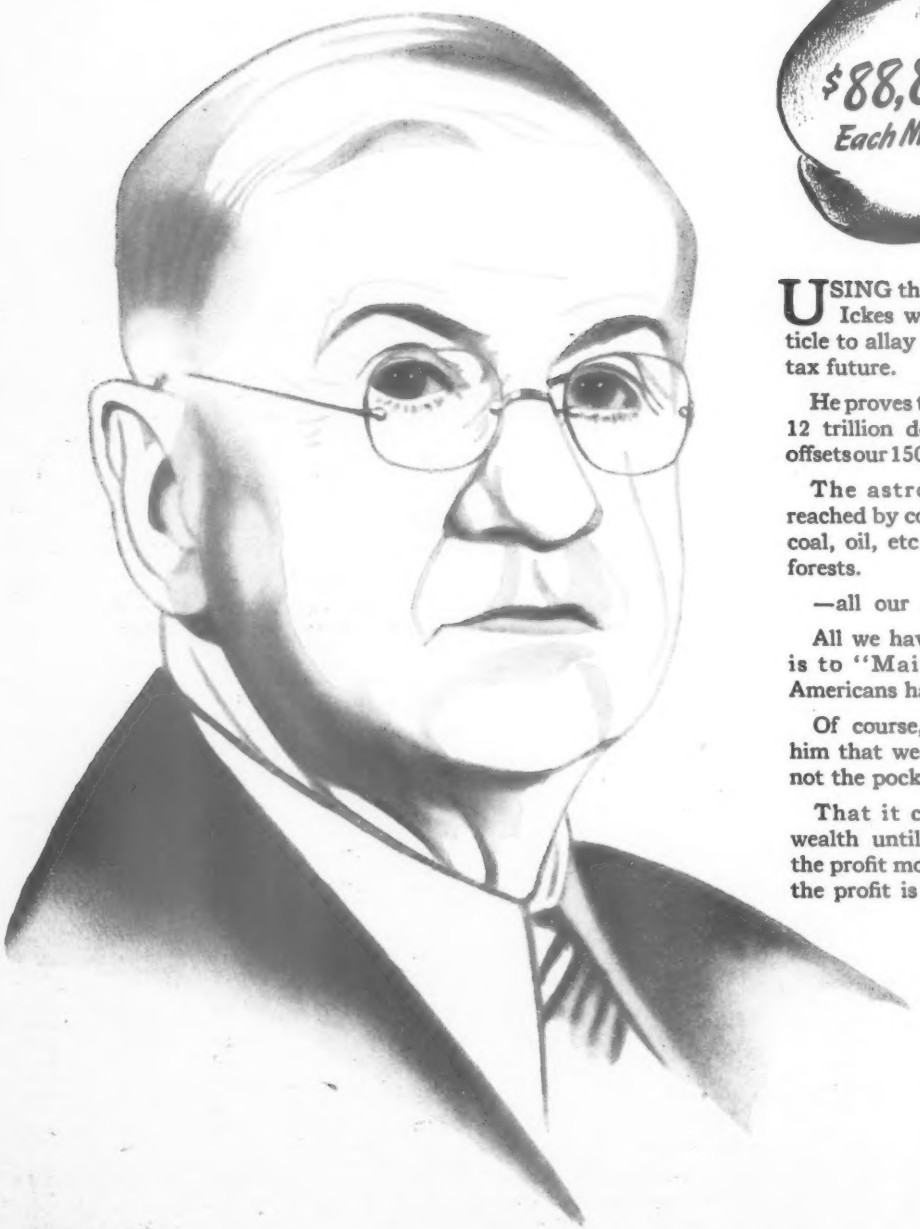
**ESTIMATED WORLD CRUDE-OIL PRODUCTION**

| | Total (thous. of bbl.) | | | Barrels daily | |
|---|---|---|---|---|---|
| | 1943 | 1942 | Change | 1943 | 1942 |
| **North America:** | | | | | |
| Canada | 10,100 | 10,300 | —200 | 27,650 | 28,300 |
| United States | 1,510,000 | 1,386,645 | +123,355 | 4,137,000 | 3,799,030 |
| Mexico | 35,000 | 37,000 | —2,000 | 95,900 | 101,370 |
| Total | 1,555,100 | 1,434,005 | +121,095 | 4,260,550 | 3,929,700 |
| **South America:** | | | | | |
| Argentina | 24,000 | 23,275 | +725 | 65,750 | 63,710 |
| Bolivia | 290 | 285 | +5 | 800 | 780 |
| Brazil | 290 | 240 | +50 | 775 | 630 |
| Colombia | 13,450 | 10,550 | +2,902 | 36,850 | 29,000 |
| Ecuador | 2,500 | 2,350 | +150 | 6,850 | 6,450 |
| Peru | 14,600 | 13,628 | +972 | 40,000 | 37,350 |
| Trinidad | 22,000 | 21,500 | +500 | 60,275 | 58,900 |
| Venezuela | 182,500 | 150,000 | +32,500 | 500,000 | 410,950 |
| Total | 259,630 | 221,866 | +37,764 | 711,300 | 607,830 |
| **Europe:** | | | | | |
| England | 985 | 730 | +255 | 2,700 | 2,000 |
| Hungary | 5,475 | 4,400 | +1,075 | 15,000 | 12,050 |
| Italy* | 750 | 1,350 | —600 | 2,050 | 3,700 |
| Germany† | 10,950 | 10,000 | +950 | 30,000 | 27,400 |
| Rumania | 36,500 | 37,800 | —1,300 | 100,000 | 103,550 |
| U.S.S.R.‡ | 237,250 | 214,000 | +23,250 | 650,000 | 586,300 |
| Total | 291,910 | 268,280 | +23,630 | 799,750 | 735,000 |
| **Asia:** | | | | | |
| Bahrein Island | 7,300 | 7,250 | +50 | 20,000 | 19,900 |
| Burma | ..... | 2,500 | —2,500 | ..... | 6,850 |
| China | 730 | 730 | ..... | 2,000 | 2,000 |
| India | 2,500 | 2,500 | +100 | 7,100 | 6,850 |
| Iran | 75,000 | 75,000 | ..... | 205,500 | 205,500 |
| Iraq | 27,375 | 14,600 | +12,775 | 75,000 | 40,000 |
| Japan§ | 3,800 | 3,800 | ..... | 10,400 | 10,400 |
| Netherlands East Indies¶ | 12,250 | 3,000 | +9,250 | 30,000 | 24,650 |
| Saudi Arabia | 5,475 | 5,350 | +125 | 15,000 | 14,650 |
| Total | 140,500 | 120,630 | +19,900 | 385,000 | 330,800 |
| **Africa:** | | | | | |
| Egypt | 9,125 | 8,750 | +375 | 25,000 | 24,000 |
| Unclassified | 350 | 350 | ..... | 950 | 950 |
| World total | 2,256,615 | 2,053,971 | +202,664 | 6,182,500 | 5,627,370 |

*Includes Albania. †Includes Austria, Czechoslovakia, Poland, France. ‡Includes Asiatic U.S.S.R., part of Sakhalin. §Includes Formosa, part of Sakhalin. ¶Includes Brunei, Sarawak.

*—then he said to himself*

# "We are every one a Croesus"



USING those words, Multi-Job Ickes writes a magazine article to allay all fears of a terrible tax future.

He proves that America is worth 12 trillion dollars—which neatly offsets our 150 billion debt (to date).

The astronomical figure is reached by computing all the iron, coal, oil, etc., in the ground and forests.

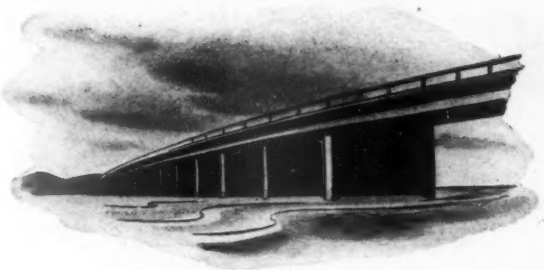
—all our *natural resources*.

All we have to do to pocket it is to "Maintain the freedom Americans have enjoyed."

Of course, his inner self tells him that wealth in the ground is not the pocketable kind . . .

That it cannot become real wealth until it is worked—until the profit motive is applied—until the profit is secured.

# Here, Mr. Ickes, is Real Wealth

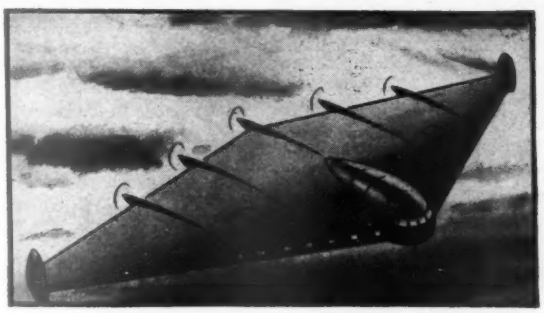


**Bridges** (Case History)

The public hears only about the spectacular big bridges. But in 1940 and '41 about $30,000,000 was spent on 40′ to 80′ bridges. A bridge engineer has written an article, "Steel and Concrete Bridges Compared" showing how nearly $3,000,000 can be saved annually on such bridges by *recourse* to Arc Welding.

**Earthmoving Machines** (Case History)

*Recourse* to Arc Welding made possible the design of a wheel-type tractor unit at a yearly production saving of $348,000 over conventional construction. Use of 600 units of this type of equipment on hauls of 5000 feet saves $10,764,000 annually over conventional earth-moving equipment and methods.



**Aircraft** (Case History)

Research now has developed a successful method of arc welding magnesium alloys, *recourse* to which shoots into terrific potentials. On the all-wing plane (on the way) the difference in drag between the conventional riveted airfoil and the low-drag arc welded magnesium wing is estimated at 50% . . . saving 20 cents per ton-mile—or $1,875,000 over the life of the plane—or $750,000,000 on a 400-ship fleet.

**Watercraft** (Case History)

Arc Welding in ship construction saves time and steel (about 10%-20%). But that's only the beginning. *Recourse* to Arc Welding also cuts costs in other ways. By eliminating bumpy rivet heads, it makes it easier to insulate the ship . . . to cover the deck . . . to run the piping . . . dozens of refinements. Such items aggregate yearly savings of about $600,000,000 according to one authority.

Someone could well write a magazine article proving a potential of WELD WEALTH equal to the national debt.

But there again the money is not pocketable until ARC WELDING is used . . . until the article is read and acted upon.

Even now the press is full of articles showing the money value of arc welding. Not all the people who should read them *do* read them. Which makes one feel that there is little difference between a man who cannot read and one who does not.

**THE LINCOLN ELECTRIC COMPANY, CLEVELAND, OHIO**

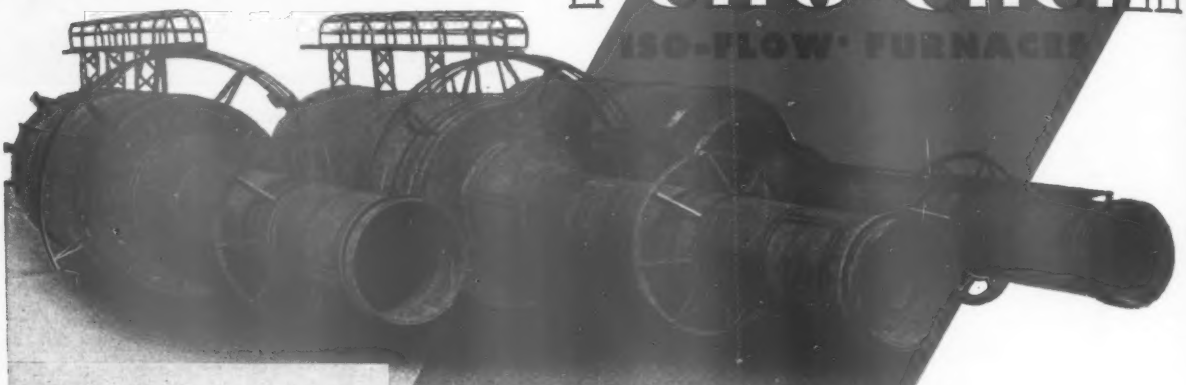
*America's greatest natural* **recourse**

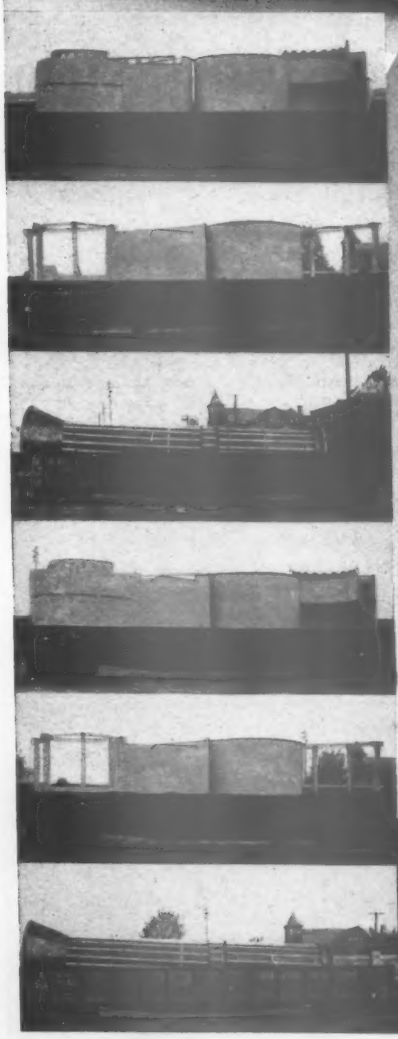
# ARC WELDING

# 3 of the 7

## Petro-Chem

ISO-FLOW* FURNACES





**...on their way to the Near East for the manufacture of AVIATION GASOLINE**

All Petro-Chem Furnaces are prefabricated and shop-assembled for final inspection . . . then they are knocked down for rail or marine transportation . . . on arrival at the refinery site they are assembled with a minimum of labor and time . . .

SIX CARS OF ISO-FLOW* FURNACES ON THEIR WAY TO THE NEAR EAST FOR THE MANUFACTURE OF AVIATION GASOLINE . . . FURNACE STRUCTURE, STACK, PLATFORM, FURNACE TUBES, REFRACTORY BRICK AND INSULATION . . . COMPLETE TO THE SPARE PARTS.

*Reg. U.S. Pat. Off. Patents Issued and Pending

PETRO-CHEM DEVELOPMENT CO., INC.
120 EAST 41st STREET, NEW YORK 17, N. Y.
Representatives: Faville-Levally Corp., Chicago
Bethlehem Supply Co., Tulsa, Houston, Los Angeles

cember 31. This presages a new record for the world's largest oil-exporting country in 1944.

European production is expected to show a substantial increase in 1943. It was known that favorable areas existed in Hungary which could be developed to an extent possibly sufficient to double production there. In view of the need, it is probable that this development was undertaken. The reopening of pipe-line outlets plus the influx of substantial quantities of oil-field equipment from the United States undoubtedly stimulated Russian production. It is doubtful if Rumanian output declined more than normal in spite of the bombing of the Ploesti refineries. It was reported that the bombing destroyed 42 per cent of the Rumanian refining capacity. Since that capacity was approximately double the country's estimated production, this would indicate that sufficient capacity remained to process all the crude oil being produced there.

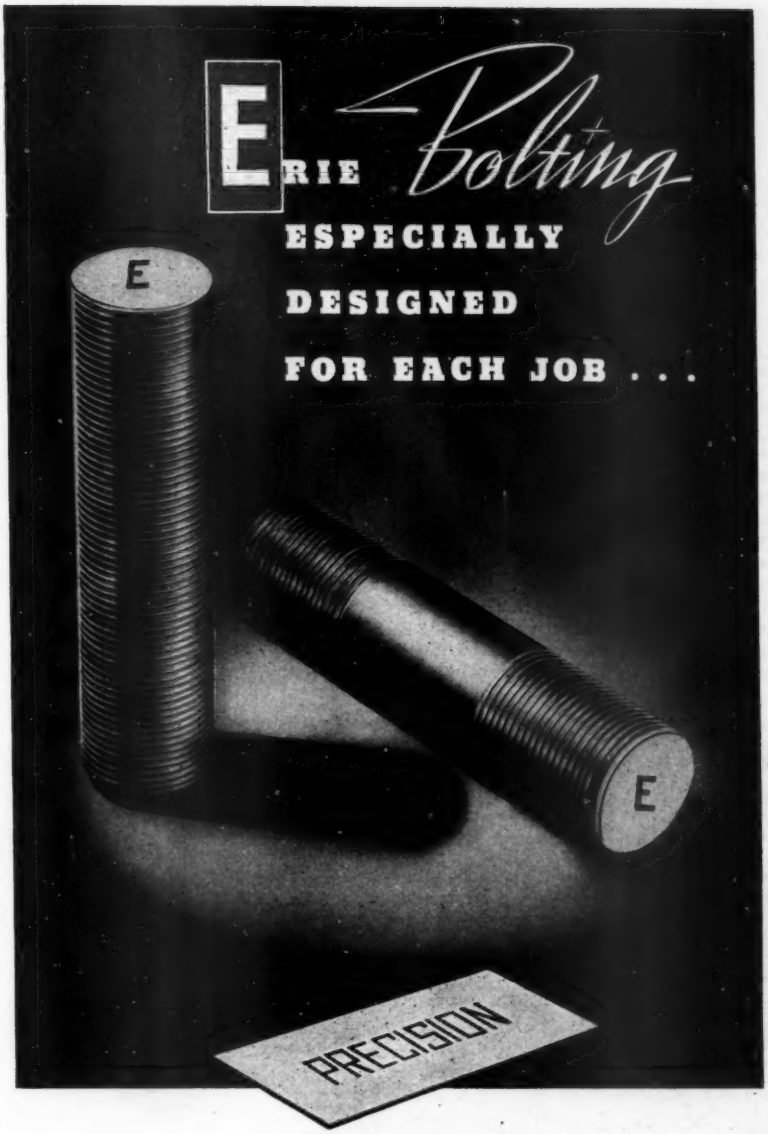
Opening of the northern leg of the Iraq pipe line, allowing for the potential doubling of that country's rate of oil production, highlighted Middle East developments. An important factor in the Asiatic picture is the East Indies, now held by the Japs. The amount of oil they are obtaining there is a subject of pure speculation. With the better part of 2 years to rehabilitate destroyed properties in the Indies, it may be assumed that they are obtaining at least a sufficient amount of oil to supply their own refineries which have a capacity estimated at from 50,000 to 60,000 bbl. daily.

The increase in production that was so widespread this year will certainly be continued into 1944 when another new record total is in prospect. With avenues of transportation again open, with all the major producing areas except the East Indies beyond the range of actual or probable warfare, with a growing military demand to be satisfied and with a deferred civilian demand waiting to be filled, all factors are present favoring a further increase.

## Chinese Oil Production Estimated at 2,000 Bbl. Daily

Crude oil production in China currently is estimated at 2,000 bbl. daily. American engineering and construction companies were consulted on the building of a refinery to process that volume of crude oil earlier in 1943. Preliminary discussions on the refinery indicated that Chinese were considering its installation in the side of a hill which would serve as protection against air attacks.

The Foreign Commerce Weekly reported 14 producing wells in Kansu, and future producing possibilities are said to exist in Sinkiang Province.


**OUR business has always been the making of bolts, studs and nuts to specifications with emphasis on the specials. Our customers are legion; 25 pieces here, a hundred there, and thousands for that special refinery-synthetic plant.**

**Today your Boss is our Boss and when we ask old customers to be patient, you know what we mean. We are working 100%, day and night, on vital war work, which as you know is scheduled by Uncle Sam with the one thought of winning the war, not of winning or holding good will. That part of business is reserved for peacetime.**

**SPEED THE DAWN OF VICTORY—BUY BONDS**

# Colombian Discoveries Indicate Extensive Exploitation Program

*by E. Ospina-Racines**

FOR Colombian oil, 1943 may be held to be one of the most encouraging exploratory years the country has witnessed recently which forecasts an intense exploitation program for the newly discovered oil fields and more extensive wildcatting just as soon as the necessary drilling equipment and machinery are made available in adequate quantities. The outstanding oil events of the past year are: Shell Oil Co.'s second discovery of a new oil field; Socony-Vacuum Oil Co.'s successful 2 Cimitarra test, brought in for 261 bbl. a day of 20° A.P.I. oil; proving of Shell's Casabe field to the point that its commercial value has been definitely established; further testing of the Socuavó-Tres Bocas area in the Barco which promises to be one of the large oil fields in the country.

Late in the year, four tests were under way in the Magdalena Department, of which three are Shell operations just north and south of El Dificil discovery well and one being by Richmond Oil Co. (Standard Oil Co. of California). Further operations may reveal the presence of additional oil fields which would have considerable economic and strategic value, being not more than 100 miles from tide water on the Caribbean.

In the Magdalena Department, Shell is drilling the San Angel, El Dificil and El Brillante tests. El Brillante is being tested, having been drilled to 10,250 ft. This is Shell's third test beyond the 10,000-ft. depth in the country. El Dificil, which discovered a new field, was spudded July 18, 1942, and completed May 14, 1943, having reached the Sierra Nevada granite basement at 5,950 ft. This represents approximately 10 months of drilling, coring and electrical well surveys for the depth indicated. Early in the drilling operations considerable gas pressure was encountered which called for a heavy mud, around 1.50 gravity. Due to a 2,500-lb. per sq. in. casing pressure, testing operations were very hazardous and only a fraction of several hundred feet of upper Oligocene limestone pay was tested. Initial yield on a ⅛-in. bean amounted to some 700,000 cu. ft. of wet gas and 54 bbl. of high-gravity oil, 46° A.P.I. The general characteristics of this crude are: Paraffin base; yields, motor fuel, 50 per cent; gas oil, 35, and fuel oil, 15 per cent. The motor-fuel cut registers a 60 octane number and about 15 per cent of the crude is suitable as aviation-base stock.

Dificil 2, located downdip, a little less than 2 miles northwest of the discovery well, was spudded July 17, 1943, or just 1 year after the first

*Above: Casabe field portsite on Magdalena River. Behind the trees is Tropical Oil Co.'s 14,000-bbl.-per-day refinery*

*Below: Field boilers being unloaded at a wildcat location on a tributary stream of the Magdalena River*

*Petroleum economist, Bogotá, Colombia.

# Synthetic Rubber to Erase a Madman's Dream

Today, an increasing quantity of our rubber is the product of chemistry and engineering — man-made in a maze of pipes and tanks.

At Baytown and Houston, Texas; at Los Angeles, California, and Akron, Ohio, new synthetic rubber plants are being erected — or are now in operation — by the Goodyear Tire & Rubber Company for the Defense Plant Corporation. At Sarnia, Ontario, a plant is nearing completion for the Canadian Synthetic Rubber Corporation.

We are proud that J. Gordon Turnbull, Inc., contributed to the design and completion of these modern plants that will help erase forever Axis dreams of world domination.

The Turnbull Organization with its engineering skill and many years of "know-how" experience has been associated also in the planning and construction of the giant North American Aviation Company plant at Dallas, Texas; the Sinclair Rubber, Inc. power facilities for the integrated synthetic rubber plant at Houston, and in many other current war-important projects.

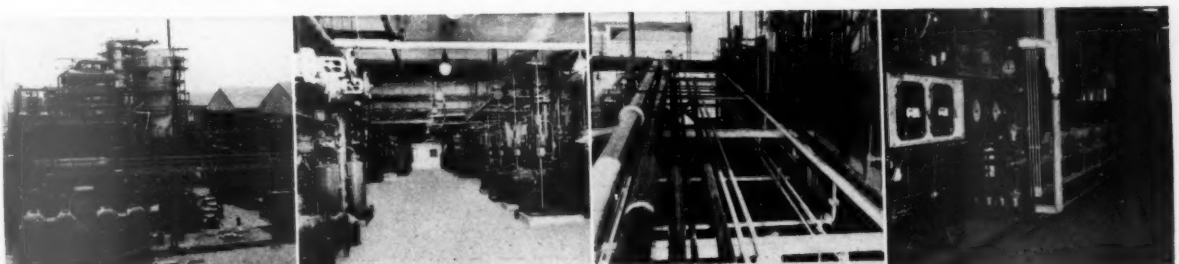
Turnbull engineering assures maximum production in the shortest possible construction time—with a minimum of critical building materials. Practical experience with "unusual" engineering problems speeds design and erection—saves precious time so vital to all-out production.

This is the proper time to start thinking of *your* post-war building projects. Perhaps a suggestion now — from our experience in many fields — may better shape your plans. We will be pleased to discuss them with you at your convenience.

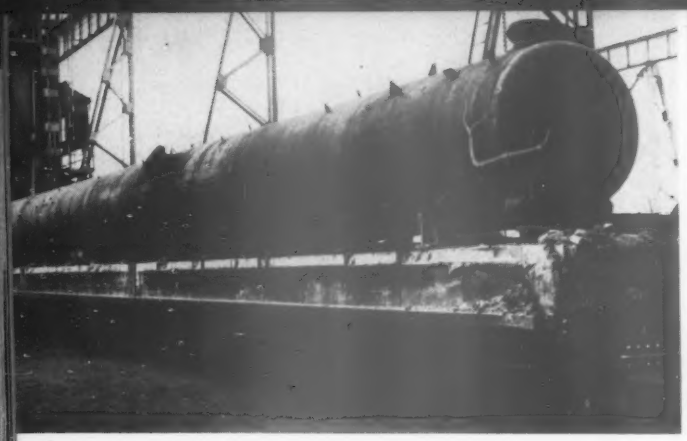
**J. GORDON TURNBULL INC.** CONSULTING ENGINEERS

*Main Office:* 2630 Chester Avenue, Cleveland, Ohio

*Branch Offices in Dallas and Houston, Texas*



REACTOR BUILDING—HOUSTON PUMP ROOM—LOS ANGELES MATERIAL INTAKE—BAYTOWN DRIER—AKRON



*This 5 ft. 6 in. diam. by 74 ft. 6 in. pressure vessel was fabricated and stress-relieved at our Birmingham plant.*

*These two 10 ft. diam. refinery drums were fabricated at one of our plants for use in the production of synthetic rubber.*

# Essential Equipment...

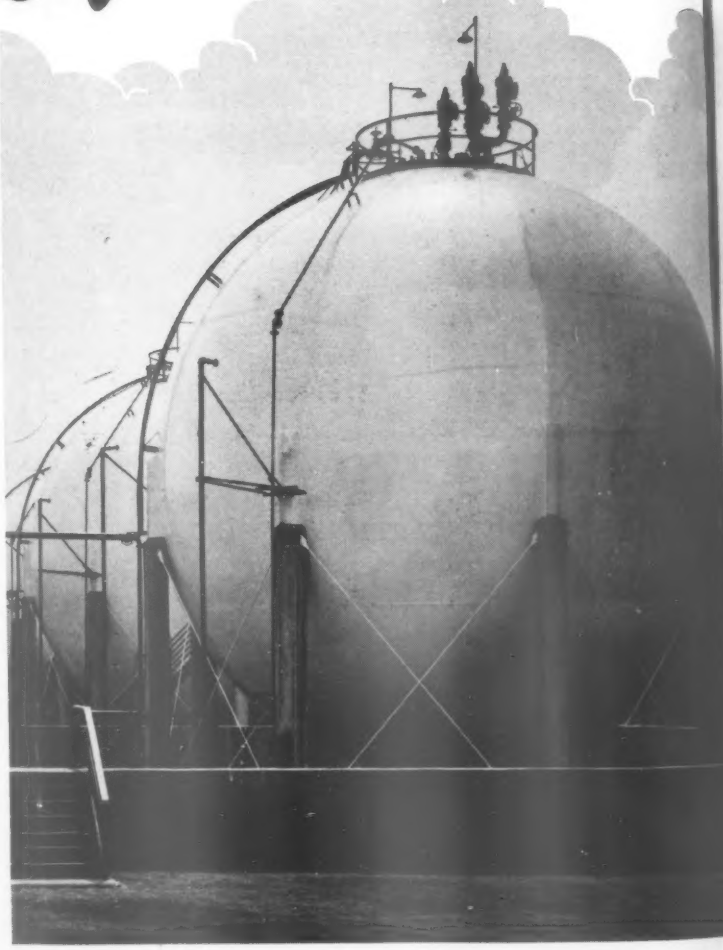
## for the synthetic rubber industry

• The pooling of the skill, knowledge and facilities of America's consulting engineers, refinery chemists and equipment manufacturers has resulted in today's tempo of synthetic rubber production. As designers and fabricators of Hortonspheres and welded steel pressure vessels, we are proud to have a part in this vital industry.

The storing and handling of butadiene is an important operation in the synthesis of rubber. In order to maintain this hydrocarbon in its liquid state it must be kept under pressure. This also prevents excessive loss by evaporation. Hortonspheres provide this type of storage because they are designed to withstand pressures built up in the vapor space at normal temperatures without venting.

At various other steps in the production of this product, welded steel pressure vessels are essential equipment. Our Birmingham plant has complete facilities for handling difficult welding and fabricating, including x-raying and stress-relieving . . . to produce vessels that meet the most exacting requirements.

Both Hortonspheres and welded steel pressure vessels are available for today's and tomorrow's needs of America's great industries. Your inquiry involves no obligation.



*• The four Hortonspheres shown are located at one of America's largest synthetic rubber plants. They have a capacity of 6,000 bbl. each and are used for the storage of butadiene at 75 lbs. per sq. in. pressure.*

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*Seneca, Ill., Shipyard*
*Newburgh, N. Y., Yard*

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*NEW YORK • CHICAGO • TULSA • CLEVELAND • HOUSTON • HAVANA*
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*Flooded roadway leading to one of Shell Oil Co.'s locations in Casabe field, Yondo concession*

test. It is drilling out plug, having set a 7-in. pipe at 5,880 ft., total depth 5,970 ft.

Richmond 1 Retiro has been drilling in upper Miocene shale and 8⅝-in. pipe has been set at 3,802 ft.

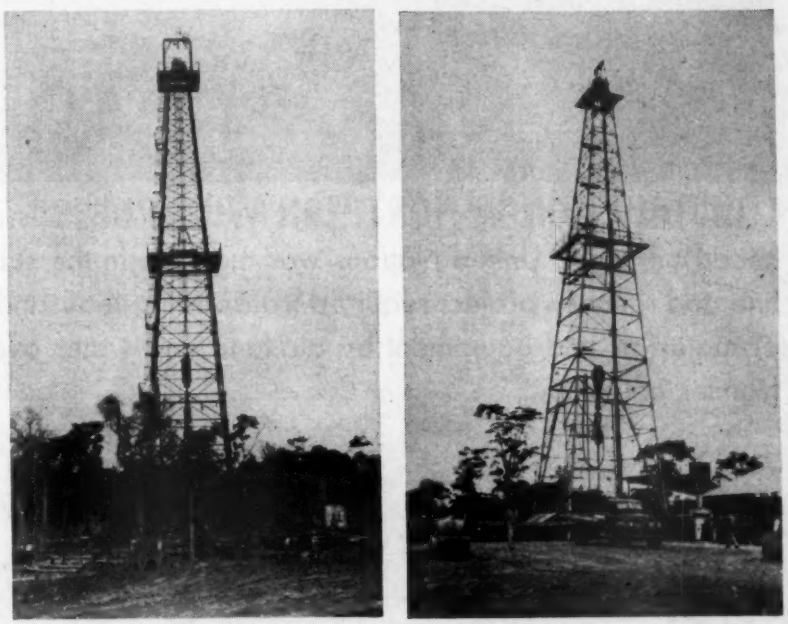
Some slight gas showings have been reported. Due to some drilling difficulties a heavy mud, running around 1.75 gravity, weighted down with local barite has been used. Due to lack of freight space and other war-import restrictions both Shell and Richmond contracted with a local manufacturer for the delivery of several hundred tons of barite, suitable for mud conditioning and have had complete success with the national product. A barite deposit has been found near the Magdalena wildcat operations and measures are being taken to exploit the deposit. Since the present barite product is obtained in the Tolima Department some 600 miles distant, the newly discovered deposit will contribute toward reducing the cost of barite.

### Middle Magdalena Discovery

In the Middle Magdalena Valley, Socony-Vacuum was successful, bringing in 2 Cimitarra for 261 bbl. a day on a ⅜-in. choke and 90-lb. casing pressure. Testing of this well commenced March 27 and ended the first days of October, revealing that such operations may require some 6 months if it is decided to test each particular promising horizon, individually, as in this case. Further wildcatting is in progress and 3 Cimitarra was spudded August 30 at location about 1,300 ft. northwest of the discovery. No. 3 has been drilled to 4,060 ft., having set 5¾-in. casing around the 3,700-ft. level. Testing work is now under way. No. 4 Cimitarra, about 2,300 ft. south of the discovery, was spudded November 1 and within 22 days had reached 2,224 ft. An 11¾-in. string was set at 497 ft. The Cimitarra area is reported highly fractured and the structure complex, bearing some resemblance to the Casabe area in this respect. Bringing in of 2 Cimitarra has favored Socony-Vacuum in the matter of fuel, some 80 bbl. being consumed daily for drilling operations at 3 Cimitarra. Although 20 A.P.I. Troco fuel reduced crude is available at Barranca, the shipment of needed quantities to Cimitarra operations entailed the use of small barges and a continuous supply movement. The fuel is now available right on the spot and piped to the other wildcats directly through a 4-in. line.

Socony-Vacuum is undertaking a very interesting wildcat program in the Sinú River area in the Floresanto tract. Spudding of the first test is due before October 10, 1944. From the standpoint of location and equipment transportation this test is one of the most difficult locations. The mouth of the Sinú River is obstructed by sand bars and the river is shallow, making it navigable only a few months of the year. A special road from the coast to a river port on the Sinú has been built and movement of equipment to the drill site has been in progress for the past year.

In addition to the wildcatting mentioned, Shell is developing the Casabe field in the Yondó concession. Thirteen wells have been drilled in this field and a new zone, Caño Negro, in the Yondó block, is being prospected. Caño Negro 1 spudded on September 27 is located some 14 kilometers northwest of the Casabe field. It is now drilling around 4,000 ft. Casabe has 12 producing wells with yields ranging from 200 bbl. to 1,200 bbl. per day of 21.2° A.P.I. oil. No. 9 Casabe which was drilled to 6,086 ft. and only partially tested, produced a 24° A.P.I. oil obtained from the C zone, encountered in the De Mares concession 25 miles eastward. A typical recent drilling operation in the Casabe field is revealed by 12 Casabe data, as follows: Spudded, September 17; completed October 9, total depth 3,770 ft., or just 3 weeks of operating



*Two wildcat drilling wells. At left is 1 San Angel and the other is 1 El Retero, drilled by Shell Oil Co. and Richmond Petroleum Co., respectively*

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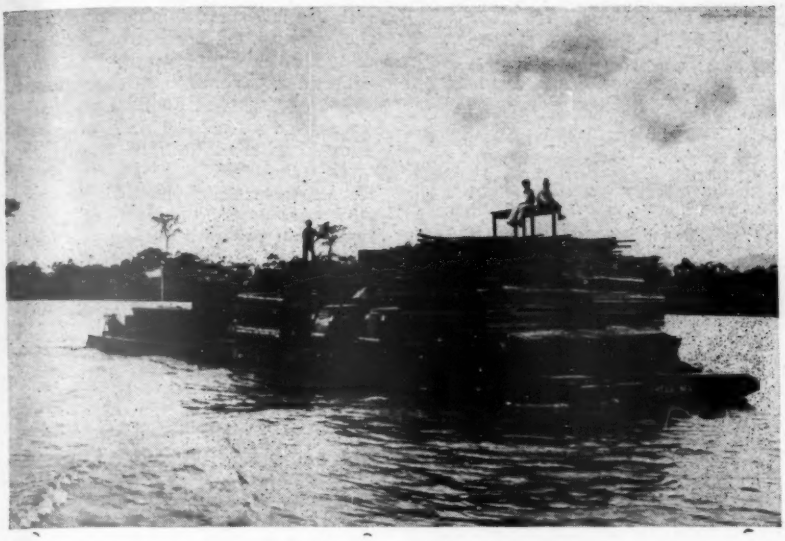
**Project illustrated: A joint venture, Bechtel-Price-Callahan**



*Transporting knocked-down building and equipment on the Magdalena to a wildcat location in the El Difícil area*

time. Casing program: 13⅜-in., 48-lb. surface pipe at 330 ft.; 9⅝-in., 36-lb. at 2,750 ft.; 6⅝-in., 20 and 28-lb. liner between 2,620 and 3,440 ft.; 2½-in. tubing set at 2,610 ft.

Currently, Shell's Casabe field has a daily potential of some 4,000 bbl. per day of 21.2° A.P.I. oil. According to the contract with the government, the operator has 30 years to exploit the concession, which, for the Yondó commences in September 1947, or 4 years hence, otherwise a legal situation is created which makes the concession subject to forfeiture. To gage the development program required to place an oil concession in the exploitation stage at great inland distances in Colombia, Table 1 has been compiled from official data showing a comparison of the oil development experience in the country. The data are the only commercial oil experience of Colombia and some very interesting conclusions may be gathered from the table.

### Long Development Lag

As may be observed from the data, both the De Mares and Barco concessions represent the development of oil fields during normal business periods, that is, when no restrictions were imposed on drilling and other oil-field equipment, likewise when no ceiling prices on crude oil prevailed. It is of interest to note the long time period between the concession contracts, 1918, 1931, 1938, also the 8-year period between the contract date and pipe-line shipments. It is evident that the exploitation of Colombian oil has been a long-term proposition.

Item 11, the footage drilled in the concession per producing well is an index as to the exploratory activity carried out with the drill. As may be noted the Yondó reveals more than three and twice the footage as the Barco and De Mares concessions, respectively. The average yield per producing well when pipe-line shipments started, which dropped subsequently as drilling progressed, is relatively low. The governing factors which make an oil deposit a commercial proposition are three, namely, the volume of oil which can be produced technically and economically from a given field without injuring it; the price of the crude at tidewater, to which are linked the gravity and other characteristics of the oil; the cost of moving it to seaboard. With prevailing ceilings, the crude-oil price becomes a constant and the only variable over which the operator may exercise some control is the volume of oil that is shipped for a given pipe-line capacity. The volume of oil which may be exploited of course is a function of the drilling and development program made possible with the war restrictions on equipment and oil-field material.

### Deferred Drilling in Prospect

In the Barco concession, Colombian Petroleum Co. (Texas-Socony), has deferred an intense development program owing to the lack of an adequate amount of equipment and drilling material. Wildcatting, on a reduced scale, is in progress in the promising Socuavó-Tres Bocas area. Socuavó 5 was recently completed around the 5,000-ft. level and testing is under way. Road is under construction for 4 Tres Bocas. The Socuavó-Tres Bocas structure has two pay formations, a Tertiary limestone at 4,000 to 5,000 ft., and a Cretaceous limestone at 9,000 to 10,000 ft. A high gas yield was obtained in the 2-A Tres Bocas from the lower pay, along with high-gravity oil, factors which point to an economic exploitation of the deeper zone. A typical drilling record, for 2-A Tres Bocas, is as follows: Spudded July 10, 1941; completed August 5, 1942, total depth, 9,228 ft.; yield, 430 bbl. a day of 54.8° A.P.I. oil from a fraction of total pay; 2,277,000 cu. ft. of wet gas at 2,900-lb. casing pressure; casing program, 18⅝-in. surface string 78-lb., set at 57 ft.; 13⅜-in., 61 lb., set at 1,338 ft.; 9⅝-in., 40 to 60-lb., at 5,515 ft.; 7-in., 26-25 lb., at 8,867 ft. Since the Barco has a pipe line whose present capacity is 25,000 bbl. a day and with additional pump stations is rated at around 70,000 bbl. daily, this prospective oil area of Colombia only requires an intense development program which will be made possible by obtaining drilling and other oil-field equipment in adequate quantities.

As of June 1 of this year, the Min-

**TABLE 1—COMPARISON OF OIL DEVELOPMENT EXPERIENCE IN COLOMBIA**

| | Normal period | | War period |
|---|---|---|---|
| 1. Business conditions | | | |
| 2. Operator | Tropical | Texas-Socony | Shell |
| 3. Concession | De Mares | Barco | Yondó |
| 4. Distance inland, miles | 335 | 261 | 300 |
| 5. Contract year | 1918 | 1931 | 1938 |
| 6. Year pipe-line shipments started | 1926 | 1939 | .... |
| 7. Approximate period elapsed (No. 5-6), years | 8 | 8 | .... |
| 8. Footage drilled in concession: | | | |
| First of the pipe-line year | 182,751 (Jan. 1926) | 67,966 (Jan. 1939) | .... |
| End of the pipe-line year | 336,073 (Dec. 1926) | 116,279 (Dec. 1939) | .... |
| 9. Footage attained in concession when pipe-line shipments started | 261,109 | 105,000 | 67,357 (Nov. 1943) |
| 10. Producing wells completed when pipe-line shipments started | 105 | 65 | 12 |
| 11. Dividing No. 9 by No. 10, average footage per well, index | 2,480 | 1,620 | 5,250 |
| 12. First 6 months' shipments, average daily deliveries (bbl.) | 27,800 | 13,000 | 4,000 (Potential now) |
| 13. Dividing No. 12 by No. 10, maximum daily output per well, index (bbl.) | 280 | 200 | .... |
| 14. Average f.o.b. crude-oil price first 6 months shipments | $2.04 | $1.41 | .... |
| 15. Average gravity of crude, °A.P.I. | 28 | 45 | 21.2 |

istry of Petroleum reported 24 concessions under contract, covering 876,071 hectares (2,160,000 acres) of a total of 3,750,152 hectares (9,270,000 acres) encompassed by 75 applications filed and accepted since 1931. Since June 1 of this year, 51 additional applications have been filed, whose total area may be placed at around 2,500,000 hectares (6,175,000 acres). The area of the 75 oil-concession bids accepted as of June 1, together with the 51 newly filed bids represent an area of approximately 6,300,000 hectares (15,550,000 acres) earmarked for exploration since the passage of the oil law in 1931. This is approximately 30 per cent of the prospective oil land of Colombia. In addition to the above area 704,625 hectares (1,735,000 acres) of private oil land are under lease, of which approximately half has been recognized with a firm title and the balance with a tentative decision in its favor. These statistics point to an extensive wildcat program just as soon as war conditions permit and will be carried out in various promising sections of the country.

### Outlook for 1944

According to national concession contracts wells are scheduled to be spudded during 1944 as follows: Socony-Vacuum, on the Floresanto tract, in the Sinú River area; Richmond, in the San José tract in the Llanos, not later than December 26, 1944; Shell, in the San Martin tract in the Llanos, not later than February 10, 1944. The latter two tests will be carried out on 100,000-hectare concessions (247,000 acres) and are the most interesting wildcats scheduled in Colombia for the coming year. The Llanos tests are the first to be carried out in this region of Colombia which comprises 50 per cent of the prospective oil land of the country.

Oil production, which has suffered a serious drop since the war due to lack of tankers, has recovered recently and the expectation is that very shortly greater tanker tonnage will be allotted to Colombia. During 1941 the monthly average oil output amounted to 2,050,000 bbl., which includes the only two concessions in exploitation. During 1942 the monthly average dropped to 875,000 bbl., the decline being exceptionally sharp during the latter part of that year. The drop was particularly significant to the fiscal income and was the object of comments by President Eduardo Santos and later by President Alfonso López in their annual message to Congress.

Crude-oil output for the country has gained steadily during the first 9 months of the year and September registered a new high since the drop experienced in 1942. About 8 per cent of the country's normal oil production is consumed domestically and the balance is exported.

During the year the Minister of Petroleum submitted to Congress a bill calling for a modification of the oil law. Some of the provisions of the bill are substantial modifications to the oil statute. These are, reduction of maximum areas granted as single concessions from 50,000 hectares to 25,000 hectares (from 123,500 to 61,700 acres) and from 100,000 hectares now allowed in the Llanos to 60,000 hectares (from 247,000 to 148,000 acres). Royalties are increased 2 per cent, which are payable at port and for the Llanos a 1 per cent increase is asked. The ceiling on the number of concessions a single operator may hold is lifted. The limit is now two concessions per operator. Other provisions deal with private oil-title recognition and the problems arising therefrom.

**TABLE 1**
**Colombian Crude Oil Production, 9 Months, 1943**
(In thousands of barrels, U. S.)

| | | | |
|---|---|---|---|
| January | 192 | June | 1,243 |
| February | 334 | July | 973 |
| March | 492 | August | 1,689 |
| April | 350 | September | 1,774 |
| May | 934 | | |

**TABLE 2**
**Status of Wildcatting in Colombia—Shown on Map November 1943**

| Wildcats— | Spudded | Present depth (ft.) | Status |
|---|---|---|---|
| Shell: | | | |
| San Angel 1 | 5-25-43 | 7,900 | Drilling |
| El Dificil 1 | 7-18-42 | 5,950 | Producer |
| El Deficil 2 | 7-17-43 | 6,120 | Drilling |
| El Brillante 1 | 12-12-42 | 10,250 | Testing |
| Richmond: | | | |
| El Retiro 1 | 5- 1-43 | 3,802 | Drilling |
| Socony-Vacuum: | | | |
| Cimitarra 2 | 8-31-42 | 6,170 | Producer |
| Cimitarra 3 | 8-30-43 | 4,060 | Testing |
| Cimitarra 4 | 11- 1-43 | 2,930 | Drilling |
| Texas-Socony in Barco: | | | |
| Socuavó 5 | 7- 5-43 | 5,000 | Testing |
| Tres Bocas 3 | Apr. 1942 | .... | Producer |
| Tres Bocas 4 | ..... | | Bldg. road |
| Shell Casabe field: | | | |
| Casabe—12 producers; 13 wells drilled. | | | |
| Caño Negro 1 | 9-27-43 | 4,000 | Drilling |

## Germans Reported to Have Increased Oil Production

German production, according to intelligence reaching this country, has been increased slightly over the past 12 months by the necessity of developing maximum output within its sphere of influence.

Hungary, the same sources reveal, offered the greatest potential possibilities for increasing production but it is not known whether Nazi industry could spare the steel and manpower necessary to intensive development. Hungary's most prolific field had been only partially developed when war started.

*Author's wildcat map, showing scope of exploratory drilling this year and projected for 1944*

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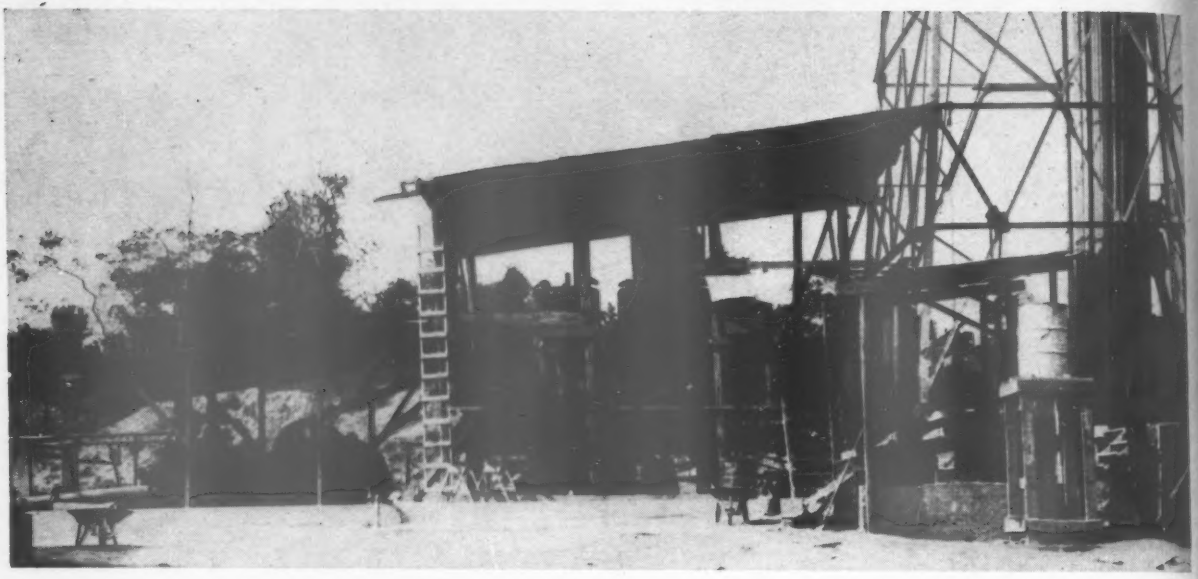

*Side view of rig at Daular, showing location of motors, draw works and pumps*

# Exploration Spreads in Ecuador

THE petroleum industry of Ecuador, while being some 30 years old, did not reach commercial status until 1925 when approximately 130,000 bbl. of production was obtained from the fields on the Santa Elena peninsula. Leasing of lands and active prospecting, however, occurred as far back as 1873 and production gradually increased to a maximum of 2,390,000 bbl. in 1940, but due to world conditions some curtailment has been necessary for the past several years. All production to date has come from the small producing wells in the Santa Elena peninsula. The first well in Ecuador was drilled by the Ancon Oil Co. in 1914, and later in 1919 near Punta Ayangue, the Anglo Ecudorian Oilfields, Ltd., drilled a well to 2,500 ft. Total wells drilled, according to available information, are as follows:

| | |
|---|---|
| Anglo Ecuadorian Oilfields, Ltd. | 615 |
| Ecuador Oilfields, Ltd. | 244 |
| Concepcion Ecuadorian Oilfields | 21 |
| Carolina Oil Co. | 15 |
| International Petroleum Co., Ltd. | 8 |
| Petropolis Oil Co. | 5 |
| Standard of California | 1 |
| Total | 909 |

Note—It is understood that all statistics quoted here are estimates owing to lack of facilities in obtaining reliable data.

Very little prospecting was done outside the Santa Elena peninsula until 1938, when the International Petroleum Co., Ltd., started active geological and geophysical work, commencing deep-test drilling in 1940. The only major oil company other than International actively engaged at the present time in prospecting, is the Shell Oil Co., which has some 10,000,000 hectares under lease in the Oriente, that part of Ecuador lying east of the Andes. Other companies interested in Ecuador are listed under the table of production, it being understood that several major companies have been in Ecuador from time to time and also currently maintain scouts looking for prospective concessions.

The oil laws of Ecuador are based more or less on those of other Latin-American countries, with the exception of the Revised Oil Law of Venezuela, and the state is the sole owner of all subsurface rights. Any person or company, foreign or national, may obtain a concession under present Ecuadorian law, provided they have proof of being a bonafide concern

*Camp for nationals at Febres Cordero, indicating how oil companies cope with the housing problem at remote exploratory locations*

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with sufficient capital and have the official approval of the Government. Concessions are granted up to 50,000 hectare blocks, except with express approval for larger tracts on the region west of the mountains along the Pacific Coast. Practically any amount may be obtained in the Oriente or on the eastern side of the Andes, where the Shell company now has, as mentioned above, 10,000,000 or more hectares under study.

Concessions are granted in two periods, one of exploration and one of exploitation. The exploration period has a duration of 5 years, after which the exploitation period commences. The exploitation period has a duration of 30 years with the option of extension for 10 years, providing the company has complied with all laws, rules and regulations and the Government sees fit to grant such extension.

At the time a concession is taken out, a guarantee bond must be deposited in the Central Bank of Ecuador amounting to S/. 10,000.00 sucres, plus S/. 100.00 sucres per 100 hectares of area under concession. This guarantee insures the period of exploration and is forfeited by the concessionnaire if the first 2 years of the period specified for concession by the contract are allowed to lapse before commencement of exploratory work. If the concessionnaire has spent a sum equivalent to the exploration bond during this time, the bond will be returned to the concessionnaire; likewise, upon sufficient proof that the concession is nonproductive, the Government, after confirmation to this effect by experts, will order the return of the guarantee to the concessionnaire and the contract is annulled.

In addition to the exploration bond, at the time a concession is granted, the concessionnaire must give the Government what is termed an "Obra de Compensación" or bonus payment, which is a certain sum of money fixed by the Government to be used for the betterment of the petroleum and mining industry of the country. For example, certain sums of these moneys have been used for the purchase of equipment for the Direction of Mines laboratories, etc.

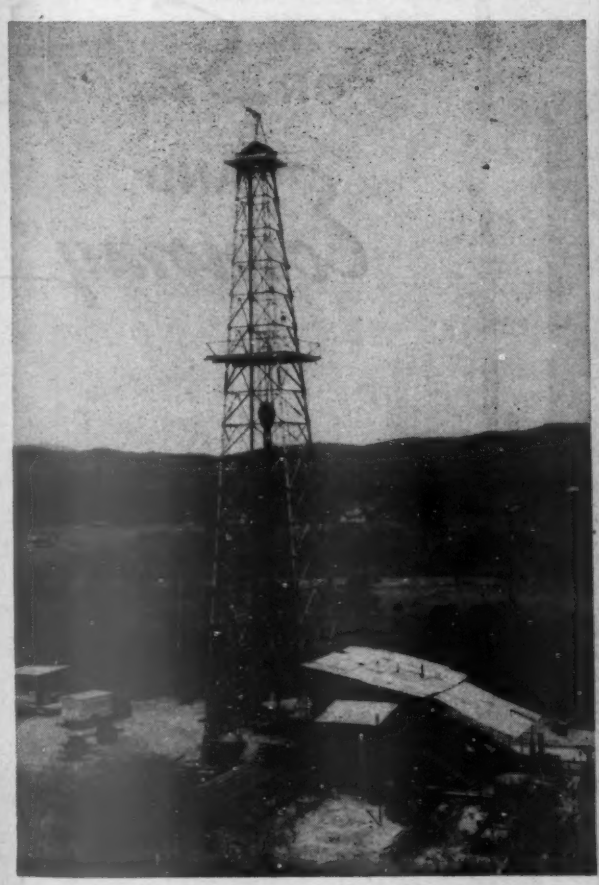
After all negotiations and payments have been made for the acquirement of concessions, annual surface taxes must be paid during the exploration and exploitation periods, which amount to 20 ctvs. per hectare during the first 2 years, 40 ctvs. during the third year, 80 ctvs. in the fourth year and one sucre from the fifth and subsequently until the termination of the contract, including any extension if such is granted.

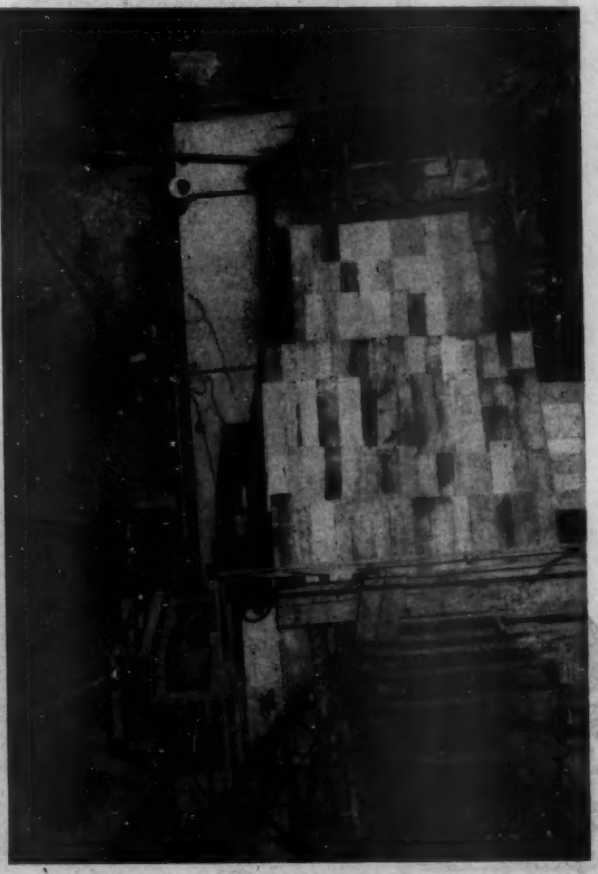
In the Oriente region and in accordance with the extent of the area granted, the Government may establish appropriate surface taxes. With regard to farmers' and squatters' rights established prior to the contract or commencement of wells, concessionnaires must pay in the event they occupy the improvements, although only partially by the exercising of such right of way, damages in the amount which is established, on the advice of experts, by the Ministry of Mines.

The state, as sole proprietor of the subsurface wealth, participates in the production of petroleum obtained by each concessionnaire of exploration or exploitation rights. This participation is computed in accordance with the distance between the collecting center of the respective fields and the nearest point of embarkation in the following manner:

| Distance (kilometers) | Per cent of net production |
|---|---|
| 0 to 50 | 10 |
| 50 to 100 | 10 |
| 100 to 150 | 9 |
| 150 to 200 | 8 |
| 200 to 300 | 7 |
| 300 to 600 | 6 |
| Over 600 | 5 |

*(Continued on page 118)*





*Left: Drilling rig at Febres Cordero. Right: View from the top of derrick, showing mud-circulation system*

Does Your drilling string have

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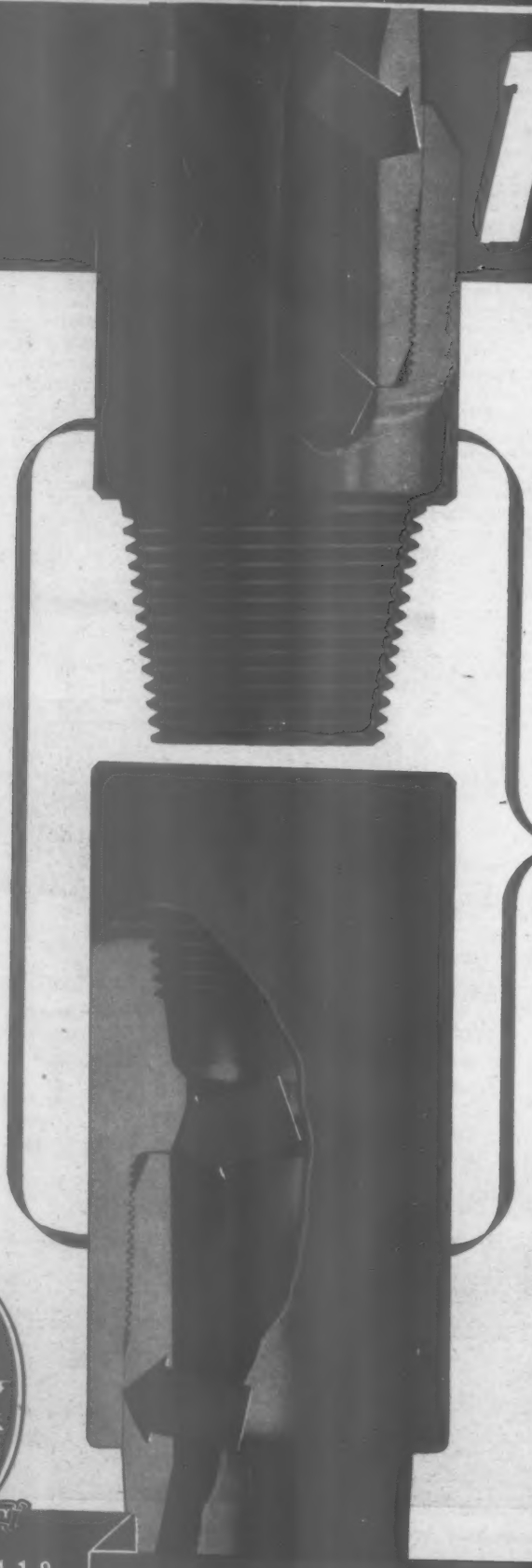

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WHEN REPLACEMENTS ARE NECESSARY

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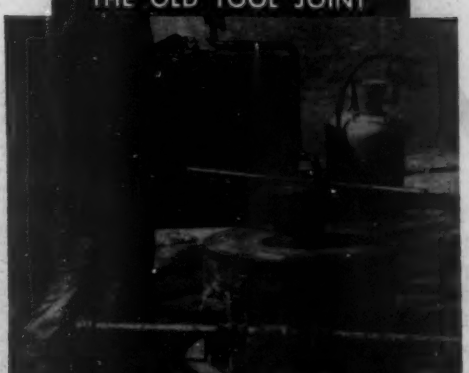

HEAT THE NEW TOOL JOINT

AND SCREW IT ON.

R RIT COMPANY

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(Continued from page 115)

Royalties may be collected by the Government in either kind or cash at the port or embarkation, or in the field. When the oil is taken from wells or deposits covered by territorial waters of the sea, the 11 per cent fixed in the above table is reduced to 9 per cent.

In addition, there are other taxes such as transportation, income both personal and otherwise, national defense tax, water-supply tax, sales taxes, import taxes, municipal taxes, and various other payments, including social security. Under social security the foreign entity must pay 1 per cent of the net profits earned in the country, whether they be foreign enterprises domiciled in the country or agencies of permanent establishments. On the payment of dividends by foreign entities in the country, the amount distributed is deducted from the net profit in determining the amount assessable to this 1 per cent tax. There are also taxes on refined products, pipe lines, etc.

### Permanent Benefits

The only companies operating on an exploitation basis with permanent camps at the present time are the Anglo Ecuadorian Oilfields and the Ecuador Oilfields, Ltd. These two companies maintain permanent establishments and camps and grant considerable privileges and benefits to their employes, both national and foreign alike. In particular they maintain commissaries and social-recreation centers, hospitals, etc. It is understood that as soon as any large organization finds a field of commercial production, all the necessary social benefits and welfare will be granted their employes. This has been proven in other countries where companies of such magnitude are operating, and it is hoped that they will shortly be able to prove to the Ecuadorian people, after finding a field, that they will enjoy such benefits.

### Exploration Provinces

Ecuador consists of three physiographic-geologic provinces. The central element is the towering double chain of volcanic peaks with its intermontane valleys, known as the Cordillera de los Andes. To the west, between the Andes Mountains and the Pacific Ocean, lies the elongate coastal region. To the east, extending from the Andes into the Amazon River country of Brazil, is the humid jungle of the Oriente.

### Coastal Region

The land west of the Andes is one of low elevations, interrupted by coastal ranges with altitudes up to 2,300 ft. The principal coastal range is the Cordillera de Chongón y Colonche, an arcuate chain, concave to the northeast, extending northwest from the city of Guayaquil on the Guayas River to the Pacific Coast, then paralleling the coastline for some tens of kilometers northward. The range is worthy of notice because it is the highest topographic feature of the coastal area, it separates the thoroughly faulted Tertiary rocks of the southwestern part of the coastal area from those of the less disturbed interior, and it represents a continuous exposure of indurated Cretaceous rock.

The area southwest of the Chongón-Colonche range contains the producing fields of the Santa Elena peninsula. The peninsula region, a semiarid tract of low, broken ground, is separated from the interior by a chain of hills of moderate elevations. Rainfall here is extremely light, and restricted to a few weeks in February and March; vegetation is correspondingly light and scrubby. The geologic features of the peninsula are a dominant fault pattern, scattered and irregular exposures of lower Tertiary rocks, and a widespread cover of Pleistocene marine beds called "tablazos." Production occurs mainly in middle Eocene sandstones at greatly varied depths. Occurrence of production owes its irregularity to the persistent faults which have made interpretation of the structural pattern an unsolved problem.

Puná Island, and the mainland between the peninsula region in physiography as well as in geological features. The land surface is marked by low hills. Rainfall is heavy during the months of January to June, when nearly all of the 45-in. average yearly precipitation falls. Roads are completely impassable during this season. The vegetation is not tropical, because of the long, very dry summer seasons. However, the growth of brushy forest is in most parts impenetrable without mechanical aids. Underlying this elongate area are greatly faulted Tertiary sediments. Exposed in the chain of hills, separating the Santa Elena peninsula from the interior are indurated micaceous sandstones and dark gray shales of Eocene age, thoroughly chopped up by innumerable faults. Toward the east are exposed in order, upper Eocene shales and sandstones equivalent to the Seca and Socorro formations; Oligocene marine brackish water, and delta deposits; upper Oligocene foraminifer-bearing shale; and Miocene marine strata. Although unconformities have been mapped between the various formations, the majority of the visible contacts are faults. Another factor which complicates the geological record is the lenticular nature of most of the strata. Accordingly, the areal extent of the various formations is extremely erratic. To October 1943 this area had

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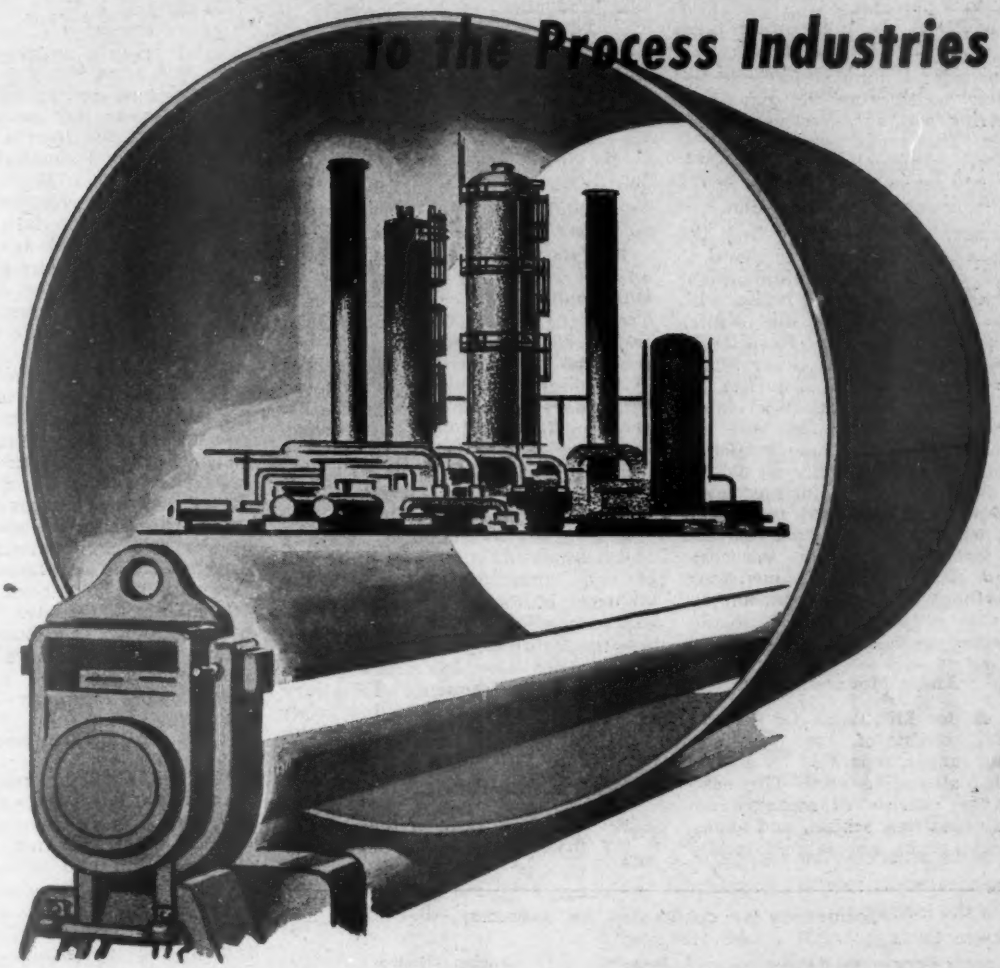
# Plate Steel Constructors

## to the Process Industries



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been tested by one deep-test well on Puná Island, and five more on the mainland to the north.

The Chonón-Coloncha range is heavily forested on its steep slopes and peneplained top. The southeastern half supports a heavy growth of brushy forest similar to that of the lowlands, while the northern half, subject to heavier rains and a thick coastal fog, is covered by tropical or near-tropical jungle. No roads and but few trails cross, so that these mountains are an effective natural barrier. The rocks exposed in the range are principally the tuffaceous, siliceously cemented sediments of the late Cretaceous Callo formation.

The large area extending from the Chongón-Colonche range eastward to the base of the Andes Mountains comprises a hilly, jungle-clad region with intense rainfall during the winter months, underlain by fossiliferous marine sediments, and, closer to the Andes Mountains, a sequence of water-deposited pyroclastics interbedded with alluvial fan and terrace material. The whole sequence, ranging in age from Miocene to Recent, is horizontal or inclined at a very low angle. Toward the north, the marine sediments merge with other formations to form the complicated stratigraphical sequence of the northern part of the coastal region. One deep-test well, 1 Solano, was drilled in this area.

### Andes Mountains

The Andes Mountains in Ecuador actually consist of two northerly trending ranges, separated by a high, central plateau-like area. The eastern range consists of strongly deformed quartzites, schists, and slates. These old rocks are capped locally by Quaternary flows and other volcanic deposits. Fossil collections from the eastern flank contain Carboniferous, Jurassic, and Cretaceous (Albian, Turonian) fossils.

The central plateau-like area of the Andes is composed of volcanic flows, agglomerate, and tuff. Bones of Quaternary mammals have been found in some tuff beds. If the Quaternary volcanics were removed from the central plateau an intermontane valley of considerable magnitude would be left between the eastern and western ranges. This is a climatically varied region, with a median temperature around 60 degrees. Rainfall in Quito, the capital of Ecuador, averages about 40 in. per year.

The western range of the Andes, where crossed by the Guayaquil-Quito railroad, is composed of hard Cretaceous marine shales, porphyritic andesites, agglomerates and tuffs probably of Cretaceous age, capped in the higher parts of the range by Quaternary volcanic deposits. Farther north, in the vicinity of Quito, strongly deformed, black shales occur.

In the Cuenca basin, which lies at an elevation of about 7,000 ft. in the southern portion of the Ecuadorian Andes, exists a section of Tertiary rocks which may have a thickness of more than 8,000 ft. Since the youngest of the Tertiary formations exposed there is of middle Miocene age, the uplift of the Western Andes is dated as late Miocene-Pliocene. Adjacent to the sequence of Tertiary sediments are the crystalline rocks common in the eastern range of the Andes.

### Oriente

The western portion of the Oriente is the foothill region of the Andes Mountains. This is an area of appreciable relief, which diminishes toward the east-lying Amazon River country. The entire Oriente is noted for its hot, humid climate and incredibly rich, thick growth of tropical jungle. At present the Shell company is exploring the region by geophysical and geological means.

### Drilling Conditions

In the past 3 years a total of seven rotary wells have been drilled in Ecuador by the International Petroleum Co. Total depths have varied from 5,100 to 7,725 ft. Formations presented have ranged from hard conglomerate material in which a rock bit would drill less than 20 ft. to soft clay-type shales in which fishtail bits have drilled as much as 1,800 ft. Salt-water pressure has been encountered requiring a drilling fluid weighing 110 lb. per cu. ft. for its control and in one well 72-lb. per cu. ft. mud was lost to the formation. Locations have been as near as 40 km., by road, from Guayaquil or 1 hour by car; and as far as 240 km. by river or 25 hours by motor launch. On all locations, camps for the foreign staff and for the national workers have been maintained because local housing accommodations and food supplies have been either nonexistent or inadequate. These camps are constructed or portable, close-to-nature houses and are dismantled and moved with other equipment to the following location.

### Drilling Equipment

All the above mentioned seven wells have been drilled with two power rigs, each powered by three D-17,000 diesel engines. One rig is equipped with two 14-in. by 7¼-in. mud pumps and the other with two 14-in. by 7½-in. pumps. Draw works and motors are mounted on two trailers for portability and mud pumps are singly mounted V-belt drives so that they can be moved separately.

Seventeen-inch surface hole for setting 13⅜-in. o.d. surface pipe is drilled to between 500 and 550 ft. with 4½-in. o.d. drill pipe and 8⅝-in. hole carried to around 6,200 ft., also with 4½-in. drill pipe. If necessary the hole can be reamed to 12¼-in. and a protective string of 9⅝-in. casing set. Rig capacity prevents carrying the hole deeper with 4½-in. o.d. drill pipe thus necessitating the setting of 6⅝-in. casing around 6,200 ft. before continuing with 5¾-in. hole and 3½-in. drill pipe.

One rig is equipped with a vibrating screen-type shale shaker powered by a small gasoline motor; and the other a rotating drum, self-propelled shale separator. Mud pits and ditch are constructed of concrete and for rainy-season locations a concrete mat is also run around

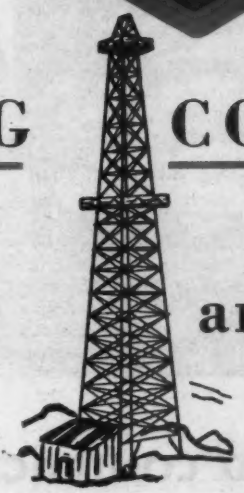
**PRODUCTION BY COMPANIES (IN BARRELS)**

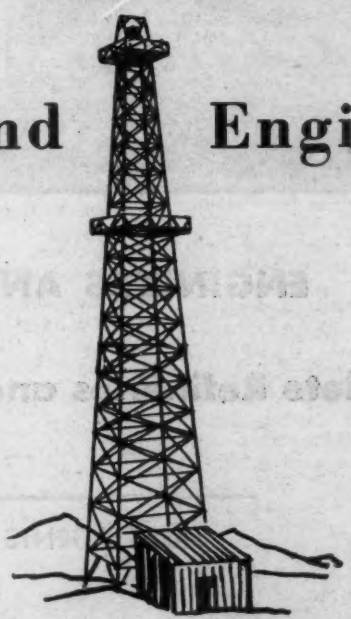
| Year | Anglo Ecuadorian Oilfields | Ecuador Oilfields | Carolina Oil | Ecuador Tropl. Oil | I.P.C. | Concpn. Ecuadr. Oil | Petropolis Oil | Total |
|---|---|---|---|---|---|---|---|---|
| 1935 | 120,875 | ..... | 8,763 | ..... | ..... | ..... | 728 | 130,366 |
| 1936 | 280,227 | ..... | 8,222 | ..... | ..... | ..... | 696 | 289,145 |
| 1937 | 429,591 | ..... | 5,636 | ..... | ..... | ..... | ..... | 435,227 |
| 1938 | 1,022,963 | ..... | 6,650 | ..... | ..... | ..... | ..... | 1,029,633 |
| 1939 | 1,300,831 | ..... | 16,903 | 706 | ..... | ..... | ..... | 1,318,430 |
| 1940 | 1,536,635 | 33,635 | 20,443 | 500 | | 449 | ..... | 1,591,752 |
| 1941 | 1,713,911 | 41,341 | 35,062 | 1,007 | 1,481 | 7,245 | ..... | 1,799,947 |
| 1942 | 1,520,639 | 42,855 | 56,786 | 247 | 422 | 12,485 | 239 | 1,633,673 |
| 1943 | 1,553,216 | 43,860 | 45,556 | 208 | 344 | 9,772 | 4,561 | 1,655,607 |
| 1944 | 1,550,600 | 43,160 | 51,821 | 846 | 1,047 | 10,779 | 4,474 | 1,662,427 |
| 1945 | 1,656,979 | 33,581 | 57,216 | 790 | 1,019 | 10,100 | 493 | 1,760,178 |
| 1946 | 1,950,848 | 28,826 | 65,812 | 2,011 | 843 | 7,936 | 862 | 1,950,848 |
| 1947 | 2,096,613 | 30,744 | 55,814 | 1,354 | 779 | 8,663 | 1,176 | 2,195,243 |
| 1948 | 2,142,933 | 30,545 | 70,698 | 1,473 | 1,577 | 10,252 | 836 | 2,286,311 |
| 1949 | 2,173,555 | 138,174 | 36,017 | 2,156 | 1,222 | 15,397 | 1,763 | 2,358,284 |
| 1940 | 1,979,236 | 360,486 | 79,256 | 1,799 | 956 | 52,836 | 16,044 | 2,390,583 |
| 1941 | 1,103,873 | 350,076 | 63,198 | ....* | 686 | 65,538 | 17,377 | 1,600,370 |
| 1942 | 1,704,399 | 396,446 | 60,499 | ....* | 494 | 95,774 | 85,019 | 2,342,631 |
| January | 184,316 | 37,006 | 4,419 | ....* | 80 | 10,245 | 15,448 | 251,513 |
| February | 159,917 | 25,807 | 3,790 | ....* | 11 | 8,546 | 13,147 | 211,218 |
| March | 96,450 | 35,375 | 3,803 | ....* | 66 | 4,941 | 12,701 | 153,336 |
| April | 109,890 | 27,184 | 3,420 | ....* | 60 | 4,530 | 11,745 | 156,838 |
| May | 148,109 | 22,340 | 3,708 | ....* | 70 | 6,290 | 11,942 | 192,459 |
| June | 134,860 | 36,457 | 3,807 | ....* | 70 | 6,102 | 12,196 | 193,492 |
| 6 months 1943 | 833,542 | 184,168 | 22,956 | * | 357 | 40,654 | 77,179 | 1,158,856 |

*Included with Anglo Ecuadorian Oilfields, Ltd.

# DRILLING CONTRACTORS

## Geologists and Engineers





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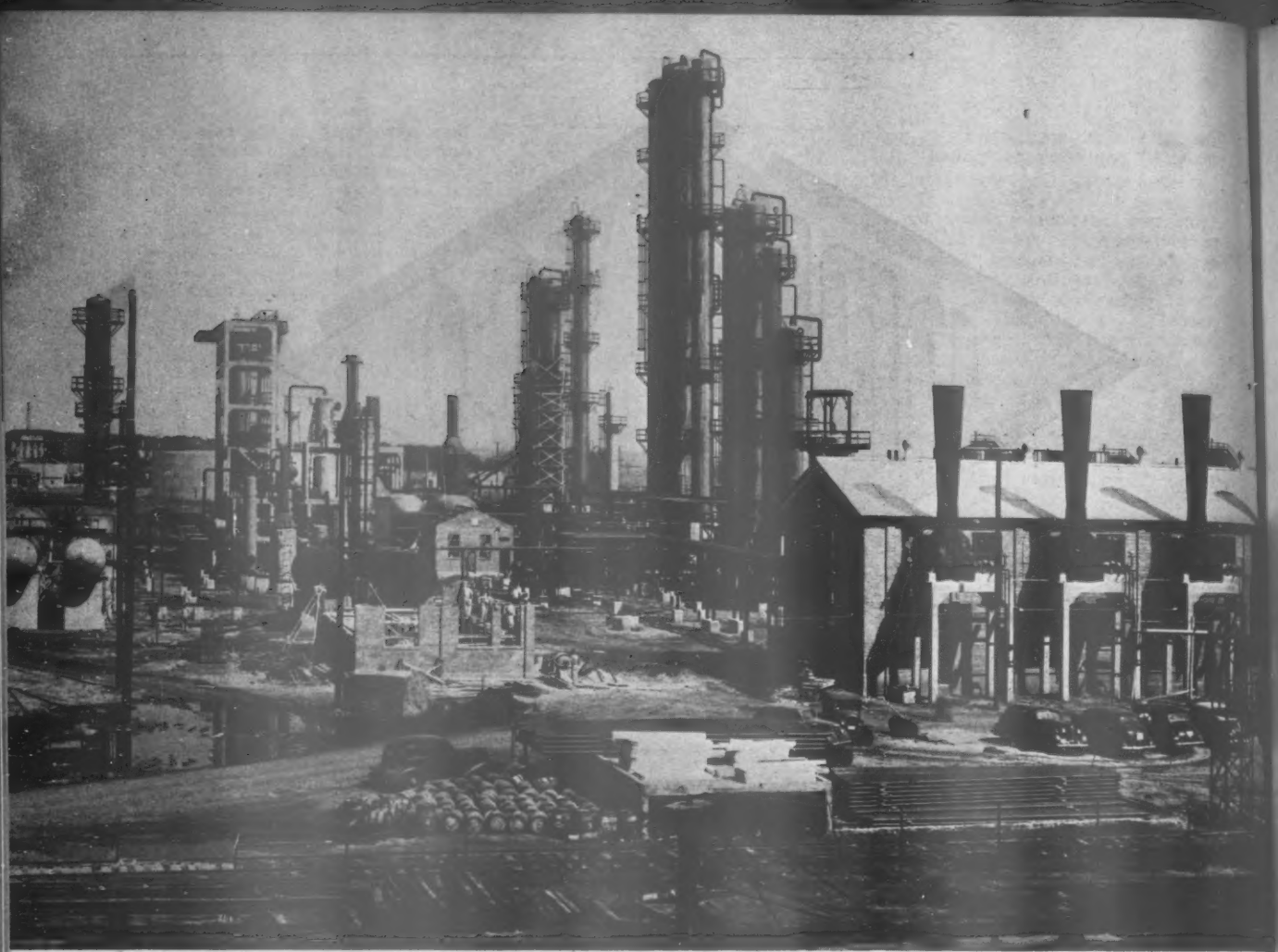

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the rig to facilitate handling of mud materials and other equipment.

### Transportation

On two locations it was possible to move the equipment on the Guayaquil-Salinas railroad, and on three locations this railroad has been used for shipping supplies after drilling started. Some wells have been so located that drilling equipment has to be moved partly by water and partly by road, and in the majority of the cases, roads had to be built with company equipment. The equipment for drilling a well located 240 km., by water, up the Daule River from Guayaquil was moved to the location over a company-built road, the last 40 km. of which was through very heavy jungle. Moving on location was completed at the end of the dry season so that by the time drilling started the river was navigable and diesel oil and other supplies were brought by boat. This well was completed before the end of the rainy season and drilling equipment was transported by barge down the river through the Gulf of Guayaquil and around the Santa Elena peninsula, to Ayangue where it was unloaded for drilling a well located about 20 km. inland. This move constituted a distance of approximately 600 km. by water and 20 km. by road between locations. The well drilled on Puné Island also necessitated transportation of equipment and supplies by water, but distances involved were not as great as the location up river.

Road building and moving a heavy equipment such as draw works, motors, and slush pumps has been done with two diesel tractors, one equipped with angledozer attachment. Heavy equipment was loaded on trailers and moved with the tractors and smaller equipment moved with trucks, where possible. Water transportation of heavy equipment has been with a 500-ton flat-top barge and smaller equipment and supplies with small barges and river boats.

### Drilling Problems

There is little comparison between formations penetrated on wildcat wells drilled by the International Petroleum Co. and the wells drilled in the producing fields on the Santa Elena peninsula. By way of contrast, the last wildcat well completed was drilled to a depth of 6,395 ft. with 12 fishtail bits and 5 rock bits or a total of 17 bits. Wells on the peninsula have acquired as many as 120 rock bits in drilling to 4,000 ft. The formations in the producing field are so hard that there is little or no danger of caving and formational pressures are not high enough to require weighted mud for their control.

Conditions is most localities have been of such a nature that constant supervision has been necessary while drilling was in progress. At the Puná Island location a high pressure salt-water formation was encountered at approximately 2,000 ft., which required a mud weight of 94 lb. per cu. ft. to prevent flow, and as depth increased, progressively higher pressure salt-water formations were encountered until at 6,200 ft., where 6⅝-in. o.d. casing was cemented. It was necessary to carry a mud weighing 110 lb. per cu. ft. The tendency of bit cuttings to mix with the drilling fluid made viscosity of the weighted mud very difficult to control, and the addition of water to reduce percentage of solids required large and expensive additions of barites to maintain mud weight.

Nearly all wells have contained sections of badly fractured, slickensided shale that cause troublesome caving during shutdown periods or while making round trips with the drill pipe and in some instances, while circulating. Water loss of the drilling mud must be reduced to a value below 10 c.c. per 30 minutes at 100-lb. per sq. in. pressure. In most cases it is necessary to use a specially treated mud and in some instances, to add starch to effect a satisfactory reduction in water loss. The well, which was located only 40 km. from Guayaquil, contained a shale section which carried a very small amount of comparatively high-pressure gas. Serious caving occurred in this gas-bearing shale section, even though mud characteristics were good and water loss was below 7 c.c. per 30 minutes. Apparently the only way caving could be controlled was by carrying a mud of sufficient density to hold all gas in place, even though the volume was extremely small and gas picked up by the drilling fluid broke out readily at the surface. The tendency of shale formations to cave is evidenced by attempts to recover uncemented sections of casing after they have been in the hole only a few weeks. It was impossible to recover more than 980 ft. of 6⅝-in. o.d. casing from the above-mentioned well, even though there was 540 ft. of surface pipe and the casing was not cemented above 5,500 ft.

Small volume, high-pressure gas sections have been encountered and sometimes have cleaned the hole, resulting in caving from the shoe of the surface pipe to the bottom of the hole. In such cases sloughing of the wells shuts off the gas and also prevents circulating. The drill pipe can usually be worked loose and pulled; however, the process of cleaning out to bottom often requires longer than was necessary to drill the hole originally.

Porous formations to which drilling fluid is lost have been encountered in only one well and in this case mud loss was not serious. A shut-off was effected by addition of Jel-Flake and Aquagel and circulating very slowly for a period of about 12 hours. Nearly all of the soft shale formations will take mud if circulation pressure increases owing to caving above the bit. In some instances an increase of 100 lb. per sq. in. above normal circulating pressure has resulted in considerable loss of mud to the formation. Such mud loss can usually be checked by pulling above the caving and cleaning out very slowly.

### Well Testing

All wells have been electrically logged before running casing, and possible gas or oil-producing sections have been tested prior to abandoning. When tested, wells that blew out or showed gas while drilling, were found to have only a small column of high-pressure gas which was rapidly depleted. In one well estimated salt-water flow was at the rate of 80 bbl. per hour and on another, actual measurement showed the well to be flowing salt water, along with a small amount of gas, at the rate of 3,600 bbl. per day.

In general, drilling conditions thus far encountered in wildcat operation in Ecuador require proper and in some instances special equipment and materials for their control. Unpredictable difficulties arise and close supervision, along with rapid remedial measures are necessary to prevent troublesome and time-consuming clean-out operations. Widely varying conditions make it impossible to establish economical counter measures, thus emphasizing the need for quickly recognizing and correcting conditions indicating further trouble.

### Production

All of Ecuador's production to date comes from the Santa Elena peninsula and is obtained by the firms listed in the following table:

*(Continued on page 134)*

**NATURAL GASOLINE OPERATIONS**

| Year | Gas treated (thou. cu. ft.) | Net prod. (gallons) |
|---|---|---|
| 1930 | * | 28,368 |
| 1931 | * | 105,800 |
| 1932 | 213,893 | 130,474 |
| 1933 | 318,409 | 140,707 |
| 1934 | 367,830 | 204,245 |
| 1935 | 372,812 | 214,946 |
| 1936 | 660,713 | 642,380 |
| 1937 | 1,631,733 | 1,377,036 |
| 1938 | 1,932,935 | 1,649,580 |
| 1939 | 2,061,183 | 1,622,803 |
| 1940 | 2,096,512 | 1,549,354 |
| 1941 | 1,496,501 | 1,221,228 |
| 1942 | 1,896,157 | 1,542,269 |

*Not available.

**1943 NATURAL-GASOLINE OPERATIONS**

| | Gas treated (cu. ft.) | Net prod. (gallons) |
|---|---|---|
| January | 223,710,000 | 161,045 |
| February | 179,658,000 | 128,393 |
| March | 108,154,000 | 78,112 |
| April | 133,196,000 | 107,866 |
| May | 157,396,000 | 135,431 |
| June | 152,467,000 | 134,409 |
| Total | 954,581,000 | 745,256 |

# Costs of Synthetic Fuels Make Foreign Development Incumbent on Oil Industry

*by J. E. Brantly*

THE primary problem of the oil industry, from the long-term point of view, is that of petroleum reserves. This is not only true of our own country but it is likewise true of all the nations of the world. At that time when the oil fields of the world can no longer supply its needs, there will still remain the great deposits of oil shales and oil sands scattered through the various countries of the world from which adequate quantities of petroleum products may be obtained for another period of time. Also, there are enormous deposits of coals and lignites from which synthetic fuels and lubricants can be derived. In addition to these natural resource materials, there are enormous undeveloped areas of rain forests in the tropics having soil suitable to the growth of crops such as sugar cane from which alcohol and its derivatives may be made.

*J. E. Brantly, president of Drilling and Exploration Co., Inc., is truly an international oil man. Much of his time in recent years has been devoted to personal supervision of rigs operated for individual companies and national agencies in South America. He was the first president of the American Association of Oilwell Drilling Contractors and is the author of a handbook on rotary drilling.*

These various sources of motor fuels and lubricants are sufficient to supply the needs of the world beyond the foreseeable future. However, none of these synthetic sources of petroleum or petroleum substitutes will yield products which equal the efficiency of the fuels and lubricants made from liquid petroleums produced from oil wells. It is, of course, possible that the efficiency of these synthetic products can, with improved methods of manufacture, be made to equal the efficiency of present-day products of the ultramodern refinery.

Likewise, the cost of a given quantity of a synthetic product is substantially more, generally two or three times as much, as the equivalent product from the oil refinery. And, in addition, labor, capital and material required to supply the needs of this nation would be enormously greater than the labor and capital employed in our present industry.

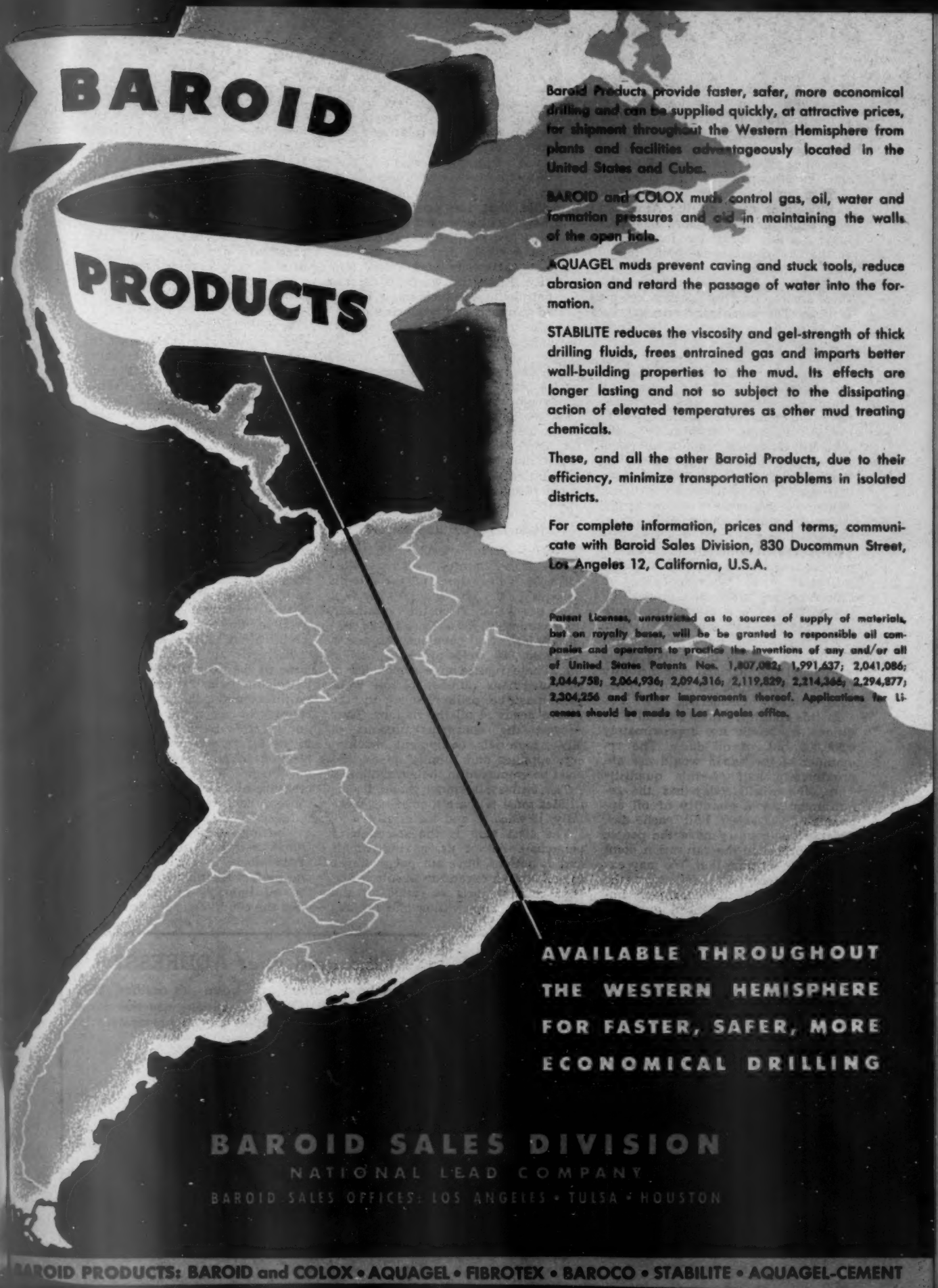
In view of the inferior quality, the vastly greater amount of labor required, and enormous capital resources necessary to the production of synthetic-petroleum products it will be important that the nations of the world exhaust their most available petroleum reserves before they can afford to use the less satisfactory and more costly synthetic products.

### An Industry Obligation

The most important job of the petroleum industry for the immediate future is to find and develop the petroleum reserves of the world and to make their production available to all of the nations.

All of the nations have the right and must receive a proportion of the oil produced throughout the world in direct ratio to their logical and reasonable requirements. It is essential that just laws, directed toward this end, be built by all nations within whose boundaries nature has established reserves. These nations must develop or must permit the development of these petroleum resources for the benefit of mankind, and in return for parting with their nature-given wealth, they must receive a just proportion of other natural resources of other nations and the various articles of industry and agriculture to provide, at least in part, for the requirements of their peoples. The peace, happiness and cultural progress of all the nations of the world depend upon an equitable distribution of their resources and the products of their skill and labor.

The petroleum industry is a development of the United States of America. The great majority of the experts in its various branches are

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Americans. Practically all of the machinery used in it is designed and manufactured in this country. The greater part of the capital therein employed is of this country. Therefore the primary responsibility for the development of the industry throughout the world in its various ramifications rests on the American petroleum industry. Our geologists must literally study the face of the earth. Our geophysicists must follow in their footsteps over that terrain on which the geologists cannot give the final answer on the justification for drilling. The machinery manufacturers must be prepared to ship their highly developed and skillfully manufactured machinery, materials and equipment to those areas in which oil might be found. Drilling organizations must be prepared to send their carefully selected, most skillful men to use the machinery furnished by the oil-well equipment manufacturers on the drilling locations designated by the geologist. The tubular-goods manufacturers must be prepared to supply proper products of their mills, adapted to the various conditions under which the line pipe must be employed and the pipeliners must be prepared to lay the lines. In the end, refineries must be established at crucial points, and finally proper distribution of the products in those quantities required must be effected.

All these things must be done under the just laws of the nations of the world and the primary responsibility for their doing rests on us, the petroleum industry of America.

In this country, under normal conditions, we would use approximately 4,500,000 bbl. of oil daily. The remainder of the world would use approximately half of this quantity. Thus, the world today has the requirement for a quantity of oil approaching 7,000,000 bbl. each day. Only in our country have the people even approached the saturation point of possible consumption. We may expect, therefore, that following the peace and with the enormous impetus that will have been given to the use of that machinery requiring petroleum products, the petroleum consuming ability of the world may easily double within a relatively brief period of years.

In this country, we seem to have reached our maximum producing capacity at 4,600,000 bbl. daily. It is probable that the producing curve will begin its downward trend within the next few months, and it does not now seem likely that this trend can ever be arrested more than temporarily. After the war the demand for petroleum products may be expected to reach our producing capacity immediately. The consuming rate or demand may be expected to increase at a substantial rate. These requirements above our producing capacity must be supplied by the oil produced within the boundaries of other nations. We must be prepared to develop their petroleum resources for them and to train their nationals in the industry. We must build drilling equipment, designed particularly to meet the conditions of foreign operations.

### Industry's Drilling Record

Since the commencement of the industry in this country, we have drilled 1,075,000 wells. Many of these wells were dry holes and about 10 per cent were gas wells. From the remainder, approximately 700,000 wells, 28,000,000,000 bbl. of oil have been produced. Some 400,000 wells are still producing. These figures give some idea of the enormous number of oil wells that must be drilled to supply the future needs of all the nations. They suggest the enormous amount of labor, materials, equipment, machinery, supplies and tubular goods that must be employed in their completion.

The entire oil industry and its affiliates must prepare themselves mentally, physically and materially.

The first step is the selection of personnel. All of us, as individuals and as nations, have our peculiarities. In sending an organization into a foreign country it is essential for the good of the organization and for our nation as well that individuals be selected who can adapt themselves or at least sympathize with and tolerate the customs and ideals of the host nation. We are too prone to send those individuals who are available rather than those whose mental processes and characteristics peculiarly fit them for the assignment. These selections should be made in accordance with a formula to be scientifically and practically developed. All individuals in a foreign organization have first to properly adapt themselves to the conditions under which and the associations with which they must work.

A group sent out on foreign operations is at best a skeleton of the organization assigned to the same job in this country. Only key men and highly skilled men can be sent. The other positions must be filled by inexperienced and unskilled nationals of the host country. These people have neither the mechanical bent, generally, nor the experience with machines and machinery common to people of our own country. Therefore the simplest, most rugged and most easily repaired and maintained machinery, equipment and supplies should be assigned. Steels should be of the finest quality. The designs should be directed toward simplicity and light weight. Controls should tend toward the automatic and in so far as possible, the elimination, or at least modification, of the personal equation.

There is an enormous job to be done in the near future years by the petroleum industry in supplying the requirements of the world. Where our country has been the major producer and greatest operator, we may expect in the future a decreasing percentage position in both production and development. We may expect an increasing number of operating rigs in foreign countries and a decreasing number in our own. We may expect a shifting emphasis on operations from our own country to other parts of the world. It is not too soon to lay and perfect the plans that will permit the oil industry of this country to meet the conditions as they arise.


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# Standard of Argentina Has Drilled Over 80 Wildcats Among 403-Well Total

THE Standard Oil Co. S.A. Argentina, an affiliate of Standard Oil Co. (New Jersey), operates seven oil fields, located in the Province of Salta and the Territory of Neuquen, two of the four major oil-producing regions of the Argentine Republic. The Salta properties are 875 miles northwest, and those in Neuquen 690 miles southwest of the city of Buenos Aires, headquarters of the company.

Active exploration was started in 1920, and the first commercial oil well was completed in 1925 when Standard discovered the Dadin field in the Territory of Neuquen. A year later the company proved the existence of commercial oil in North Argentina when it discovered the Agua Blanca field in Salta. This discovery led to extensive petroleum operations which contributed substantially to the economic development of northern Argentina.

Since the initiation of exploration and exploitation work, the company has drilled a total of 403 wells in different areas of the country, of which more than 80 were wildcats. Total discoveries have aggregated about 30,000,000 bbl. Production began in 1925 and reached a peak of 7,978 bbl. per day in February 1934, thereafter declining to 3,472 bbl. daily in August 1943, or an average of 19 bbl. per day per active well.

The Salta crudes are of Paleozoic age and are generally good lubricating-oil stocks. Neuquen oils are derived from the Jurassic and are most useful for manufacture of white oils.

In the course of its operations, Standard of Argentina has constructed over 400 miles of roads, mostly in the difficult mountainous region of northern Argentina, as well as 200 miles of pipe lines. It is operating four refineries in the country.

### Location and Age of Fields

There are four important oil-producing areas in the country, Comodoro Rivadavia, Mendoza, Neuquen and Salta, all being distinct units in the sense that they are widely separated and produce oil from sediments of different geologic ages.

**The seven known fields operated by Standard Oil Co. of Argentina have been almost entirely drilled up, having reached their respective productive peaks from 4 to 10 years ago. Newer fields in the country, mostly operated by Yacimientos Petroliferos Fiscales, have much higher potentials than current production indicates.**

The Comodoro Rivadavia field in the Territory of Chubut, in the southwestern part of the country on the South Atlantic Coast, is the most important, originally having about two-thirds of all the reserves, and now producing two-thirds of the petroleum of the country. The oil is produced from rocks of Cretaceous age. The Mendoza production currently is restricted to a few fields around the city of that name, in the Province of Mendoza, West Central Argentina. Production comes primarily from rocks of Triassic age. The Neuquen producing region is in the southwestern part of the republic, with production from Jurassic sediments. Salta is a relatively small producing area in the northwestern portion of Argentina, along the Bolivian frontier. The Salta oil is believed to have been derived from Devonian shales, but the actual production comes mostly from Permo-Carboniferous glacial sediments and, to a lesser extent, from Tertiary strata.

These three producing regions north of Comodoro Rivadavia are situated in the western portion of Argentina, just east of the Andean ranges.

By the early part of the nineteenth century, oil seeps had been reported from a number of localities along the

*Wells in the Tupungato area, Province of Mendoza, western Argentina*

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eastern slope of the Andes. In 1887 the first commercial oil well in Argentina was completed on the Cacheuta seep, a few miles west of the city of Mendoza. The heavy oil, obtained at a shallow depth, was reported to have been used for paving the streets of adjacent villages.

### Government Participation

The next and most important Argentine oil discovery was made in 1907 when the Direccion General de Minas, drilling wells in search of water for that semidesert region of Comodoro Rivadavia, found oil instead. A government reserve area was immediately set up, and served as the foundation for the present government producing company.

In 1918 the Direccion General de Minas drilled the discovery well in the Territory of Neuquen, opening up what is now designated as Camp No. 1 field at Plaza Huincul. As in the case of Comodoro Rivadavia, the government immediately set up a reserve area around the discovery well.

Oil was first discovered in commercial quantities in northern Argentina in 1926 when Standard completed 1 Agua Blanca, Salta Province, on the Argentine-Bolivian frontier.

In Argentina, mineral rights are the exclusive property of the national government in the territories which comprise approximately half of the area of the country. In the remainder of the country they are vested in the respective provinces (corresponding to the states in the United States).

### Standard's Geological Exploration

With the desire to back up its expanding local consumer market with indigenous crude production, the Standard company in 1920 surveyed Argentina to determine its petroleum resources and potential producing areas. This survey resulted in recommendations for active exploration of the Comodoro Rivadavia and Neuquen regions, and the Andean foothills in the provinces of Jujuy and Salta, where favorable sedimentary structures had been observed. In order to place its operations in the country on a permanent and substantial basis, the Standard Oil Co. S.A. Argentina was formally incorporated in 1922.

Geological parties of Standard were active in the field from 1920 to 1935. All of the national territories, however, were reserved from exploitation by private companies in 1924, thus excluding most of the favorable prospecting regions of the country from development by private operators. The reserved territories included all of Neuquen and the prolific Comodoro Rivadavia regions, excepting only certain limited categories of prexisting mineral rights. In 1935 the government entered into exclusive long-term reserve contracts with a number of the provinces, thus further restricting the areas available to private companies and forcing further curtailment of exploration activities.

### Exploration Drilling

Concurrently with the extensive geological program under way throughout the country, Standard commenced exploration drilling in Neuquen in 1921, in Comodoro Rivadavia during 1922, and finally in the Jujuy-Salta region in 1925. During the course of its operations in the Territory of Neuquen, the company has drilled 34 wildcats, discovering the Dadin field on October 10, 1925 and the west extension of Huincul field on December 7, 1937. Private interests thus found the first new fields following the original government discovery in Neuquen. Mining rights were also acquired in various localities of the Comodoro Rivadavia region, where eight wildcats were unsuccessfully drilled from 1922 to 1926.

Standard started its first wildcat well in North Argentina in 1924, this test being at Agua Blanca, Province of Salta, on the Argentine-Bolivian frontier. This exploration well resulted in the opening up of the Agua


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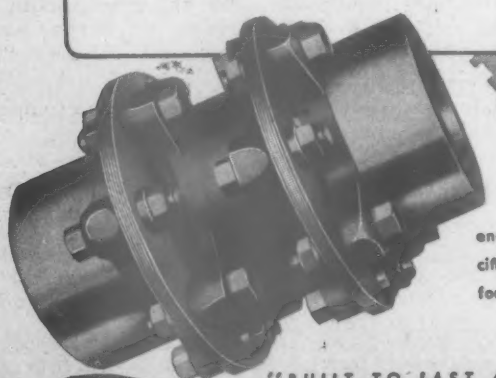

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Blanca oil field, the first production in the province, and the second Standard discovery in the country. As exploration proceeded, four new producing areas were discovered by the company, in the same province: Cerro Tartagal in 1926, Lomitas in 1927, San Pedro and Ramos in 1928. In addition to those areas which actually produced oil, 35 unsuccessful wildcats have been drilled in other localities in the province, as well as four dry holes in the Province of Jujuy, along the same general structural trend.

### Neuquen Territory Fields

All of the producing fields in this region are small pools situated on the top or flanks of the Lotena-Challaco geanticline. This is a low, broad arch which extends for 200 miles across the southeastern portion of the Neuquen sedimentary basin. It is of particular interest geologically because its core is a granite and metamorphic rock remnant of an ancient Paleozoic mountain range and, whereas the geologically young Andes Mountains have a general north-south alignment, the Lotena-Challaco geanticline, in eastern Neuquen, has an east-west trend at a right angle to the younger mountains.

Surface rocks of the Neuquen producing fields are Cretaceous and Tertiary, but the production comes from sand zones in the Jurassic. The petroleum found up to the present time has been obtained from sands lying immediately below an erosional unconformity in the Jurassic, in intimate contact with a highly bituminous, marine, brown shale, of Tithonian (Jurassic) age. There seems to be little doubt that the Tithonian shales are the source of the oil. There is a consistently close relationship between the shales and the producing sands. The ages and relative stratigraphic positions of the producing sands have not been satisfactorily established in the four pools now existing, due to the lack of critical fossils.

Some of the oil fields in Neuquen appear to be stratigraphic traps, with the Tithonian shale lying immediately upon the beveled updip ends of the sand zones, providing both an impervious cover for the sand and at the same time a source of oil; though one or two fields may be due to normal fault closure. The nature of the present fields indicates that future discoveries will largely depend upon wildcat drilling, though occasional prospects may be found by geophysical methods, as in the case of the Challaco field, discovered in 1941.

The Standard properties in the Dadin and Huincul fields comprise approximately half of the producing area in each, the other half of the fields being operated by the government, which moved in to drill offsets to the original discoveries.

*Rigging up a wildcat location in the Salta area of Argentina*

Discovered by Standard in 1925, Dadin is a stratigraphic trap accumulation, with the Tithonian shale lying across the updip, beveled ends of the producing sand zone. All of the producing wells were drilled by cable tools and, though the bituminous shale, used as datum for structure control, is apparently conformable to the dip of the producing sand below it, lean streaks longitudinally through the field, together with high angles in recent rotary cores, tend to indicate that the individual sand layers have higher angles of inclination than that of the overlying shale. The base of the bituminous shale has a north dip of about 30°, the oil-producing zone varying from 500 ft. above sea level to 1,100 ft. subsea.

### Gas Cap Absent

No appreciable gas cap was ever present in the field, and in its current advanced stage of depletion no water drive is evident. During the early stages of development the water table rose about 160 ft. above its original level, but has subsequently subsided about 80 ft. This effect could not have been due to exhaustion of the water, for very little has ever been produced. The producing zone is about 300 ft. thick with 150 ft. of sand.

There have been 106 wells drilled in the field, of which 97 were productive and 9 were dry. By August 1943, production had declined to 396 bbl. per day for the field. Gas has been injected into the sands of the field for some years, and although natural gasoline recovery has been stimulated to some extent, bypassing of gas and lack of intercommunication between sands has been such that the net value of repressuring is conjectural.

### Huincul Field

This field is divided into two separate producing areas, East Huincul and West Huincul, with different thicknesses of producing zones, probably sands of different stratigraphic positions and, at the present time, different pressures in the sands.

East Huincul, located astride the western boundary of the government reserve octagon, was discovered in 1923 by the Challaco company. In 1933, it was bought by a Standard affiliate and has since been operated by Standard. It is a circular, dome-

*Gathering station in San Pedro field, northern Argentina*

shaped structure, with a producing zone of sands and shales extending about 350 ft. below the Tithonian brown shales, with present closed-in well pressure of about 300 lb. per sq. in., and the water table uniformly at 450 ft. below sea level.

After completing exploitation of the East Huincul property, the company drilled several exploration wells, one of which discovered the Huincul west extension in 1937. This new area developed into a narrow zone, between the water table on the downdip side and the gas cap updip, extending along both sides of the property line, with the result that about half of the pool was on national territory and was immediately operated by the government company.

In contrast with East Huincul, the west extension has the appearance of an elongated, narrow, east-west fold, a gas cap with pressure of 1,100 lb. per sq. in., an oil interval of 27 ft., a sand horizon 110 ft. thick, and a water table which varies from 300 ft. below sea level in the west end of the field to 530 ft. in the eastern end. Production is almost entirely on the north side of the gas-cap area.

Through August 1943, 103 wells had been drilled in both Huincul areas, of which 83 were producers and 20 were dry holes or gas wells. With the aid of occasional flush wells each year, the production of the field has been maintained at slightly over 1,000 bbl. per day for several years. The producing sands are about 2,300 ft. deep in both sections of the field.

### Province of Salta

Producing structures of this region are located on the three easternmost parallel mountain ranges of the Andean foothills. These are narrow, somewhat tightly compressed folds, with north-south trends, and all appear to be overthrust to the east from hundreds to thousands of feet. Though the folding of the Andes culminated in Pleistocene times, the evidence indicates rapid erosion of the Salta structures after folding, with removal of 8 to 10 thousand feet of younger sediments, leaving the more resistant cores of the anticlines as prominent topographic features of the present day.

The producing fields are very similar, structurally, all being tight anticlines, slightly overturned eastward, and with low angle thrust faults at a relatively shallow depth, plunging westward into the cores of the structures from the east side. They are of unusual interest to the geologist since most of the production is obtained from glacial sediments of Permo-Carboniferous age. Standard geologists, tracing these glacial materials southward from the localities in Bolivia, designated them as the Tarija formation, though they are also known in Argentina as the Gondwana formation, since they were related to the Gondwana glaciation of late Paleozoic and early Permian times. These sediments are assumed to have been deposited under conditions much like those now prevailing on the Grand Banks of the North Atlantic, and in the waters surrounding the Antarctic Continent, where melting icebergs are forming similar accumulations. Thickness of the Tarija averages about 2,500 ft. and, due to its hardness and the large percentage of sharp sand throughout, it is both difficult and expensive to drill. Some oil is obtained from relatively unconsolidated sediments of the Tertiary, overlying the Tarija, but it has evidently migrated upward from the latter formation.

Royalty of 12 per cent, in cash or in kind, is paid to the Province of Salta, owner of the mineral rights.

### Agua Blanca

Discovered in 1926 by Standard, this field gave the first proof of commercial oil accumulations in northern Argentina. Though it was the earliest of the Salta fields, it still remains the most isolated and most difficult of access. It has been a disappointment from an economic standpoint because of the small reserves it contained and the high drilling costs. Cable tools were used in the early stages of development, but these were so slow that a hydraulic drilling outfit was brought in to speed up completions. The unit was used to complete the first well with diamond drilling bits but the sharp sands in the formation and mud were found to cut the diamonds loose from the bits so badly that use of this type of equipment was soon abandoned.

### San Pedro

Standard's most important field in Argentina is San Pedro, which produces the highest grade of lubricating crude in the country and is the company's largest single oil reserve. Daily production reached its peak of 3,967 bbl. in 1935 and has declined steadily to 1,533 bbl. per day in August 1943. The oil is obtained from two separate sand zones in the Tarija glacial grits and the wells average about 3,300 ft. in depth. Development of this field has been costly, because the wells and camp sites are located at the top of a narrow, precipitous mountain covered with tropical timber, subject to heavy rains and accompanying landslides.

### Lomitas

Second in importance of Standard's Salta fields is Lomitas, situated on the Aguaragua Mountain Range overlooking the flat Chaco Plain, with production of less than 500 bbl. per day. Produced from the Tarija formation under geologic conditions apparently identical to those of San Pedro, a few miles away, the oil is much less valuable as a source of lubricants. While some lubricating oils are manufactured from it, most of the crude is converted into white oils. The wells average about 2,400 ft. in depth.

### Cerro Tartagal

This is a small producing area on the Aguaragua Range 7 miles north of Lomitas. Though structurally higher than Lomitas, its production from the normal Tarija section is negligible, and part of the small amount of oil obtained is from the fractured area adjacent to the thrust fault.

### Ramos

When this area was first mapped, it was the largest and most promising of all the Salta structures, but subsequent exploration has been disappointing. Ten wells have been drilled on various parts of the anticline, but oil has been found in negligible quantities in only three of them. The Ramos production is of particular interest, however, because it is obtained from fine laminated sands in the Devonian shales which are believed to have been the source beds.

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# Exploration Spreads In Ecuador

*(Continued from page 123)*

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Ecuador Oilfields, Ltd.—Subsidiary of the British Controlled Oilfields, Ltd.

Carolina Oil Co.—Owned principally by the Illescas interests—a prominent Ecuadorian family.

Ecuador Tropical Oil Co.—Formerly independent, but since 1938 a subsidiary of Anglo.

International Petroleum Co., Ltd.—Subsidiary of Imperial Oil, Ltd. of Toronto.

Concepción Ecuador Oil Co.—French-British & Foreign Trust, Ltd., London, under lease from Medina-Perez family.

Petropolis Oil Co.—Another of the Illescas properties.

The accompanying table comprises the official government figures since the year 1925 to June of the present year. The figures are given by months for the first half of this year. The sharp fluctuations to be noted in recent months are the result primarily of curtailment because of the lack of tanker space. As can be seen by reference to the exportation figures, while the Anglo Ecuadorian Oilfields, has been able to maintain fairly constant though highly fluctuating rate of overseas movement, Ecuador Oilfields, Ltd. has never yet been able to establish any continuity or regularity of export. The production of this latter concern, therefore, is most probably much more severely curtailed than that of the Anglo.

Of the remaining producers, the Concepción Oil Co., Carolina Oil Co. and Petropolis Oil Co. operate under agreements with Anglo and can be regarded as partially independent subsidiaries of that concern. The Ecuador Tropical Oil Co. came completely under the control of Anglo several years ago and except for certain differences as regards status and royalties of their concessions, may be regarded as essentially a part of the latter firm.

The small production of the International Petroleum Co., Ltd. is handled by Ecuador Oilfields, Ltd. by agreement with that company.

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Alone among the various producers in Ecuador, Anglo operates a natural-gasoline plant, the throughput and production of which, according to Government figures, is as shown in the tabulation below.

Much of the gasoline produced in this plant is used to sweeten crude cargoes, though in many instances it figures as a separate item in the exportation figures. It is probable, however, that it is rarely shipped as a separate product.

*Ed Rae, second from the right, was photographed in native costume while superintending construction of fuel bases in Africa for Williams Brothers Corp. He was formerly assistant chief engineer of Great Lakes Pipe Line Co. Sam Bryden, second from the left, was one of the six superintendents on the job. In the center is the subcontractor who made concrete blocks; his chauffeur stands at the left and his partner at the right*

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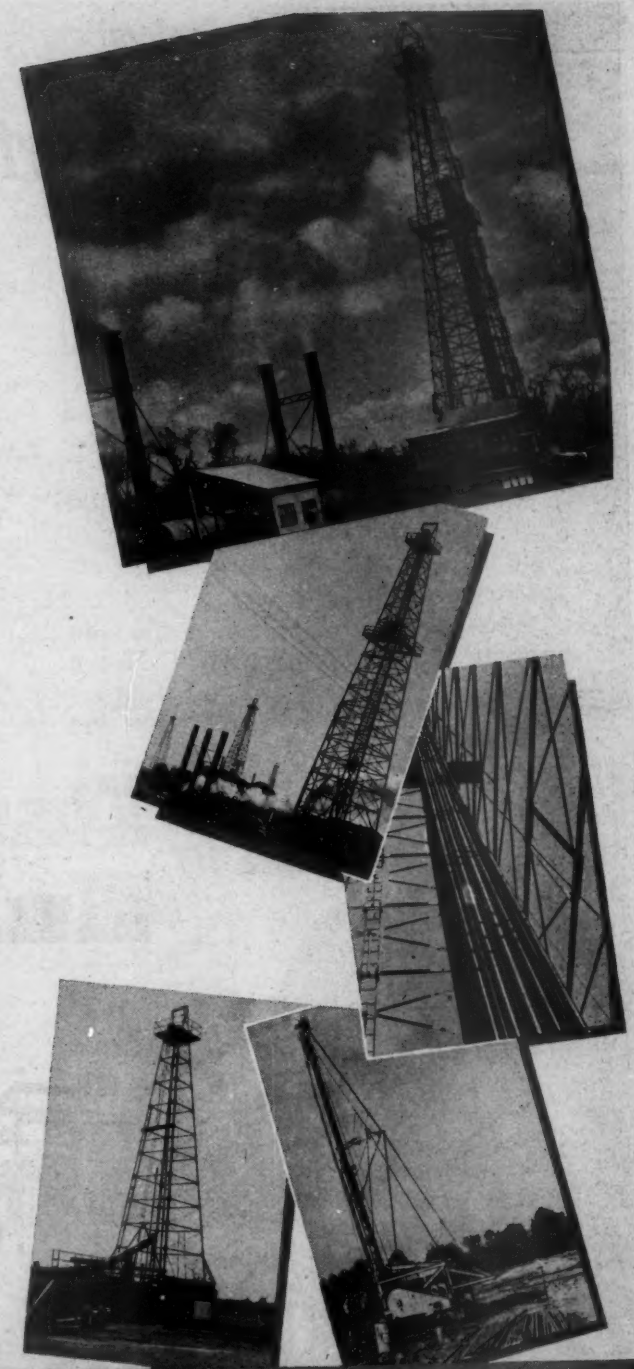

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*Photo shows Tank Farm Area for Raw Materials in the First Government Dual-Unit Type Synthetic Rubber Production Plant—of which Dayton Rubber is one of the operators.*

KEEP BACKING THE ATTACK...BUY MORE WAR BONDS!

# Tankers to Determine Trend

*by J. P. O'Donnell*

NEW YORK.—The 1944 development of oil fields held by the United Nations will be related closely to the construction of tankers during that year. The imposition of a staggering military demand on top of an only partially satisfied civilian demand has given the oil industry a market infinitely greater than any it has previously supplied. Known oil fields, developed and undeveloped, are more than capable of satisfying all these requirements and the degree to which they satisfy them depends entirely on the availability of transportation facilities, principally tankers.

The significance of the tanker is apparent from the course of world production in the last 2 years. It declined in 1942 in face of the greatest demand in the history of oil only because facilities for its transportation were lacking. In 1943, production recovered and is estimated at an all-time high because transportation facilities, thoroughly disrupted in 1942, were reorganized and expanded. Significantly the construction of tankers in United States shipyards in the first 11 months of 1943 totaled 216 vessels which compared with 62 in all of 1942. Last year, with submarines rampant, construction was unable to keep pace with losses. This year, with the submarine menace apparently under control, construction moved ahead of losses and now exceeds them by a wide margin.

A more specific instance showing the importance of tankers is given in a comparison of 1942 with potential 1944 production of certain countries. In 1942 the production of three of the more important Western Hemisphere exporting countries, United States, Venezuela and Colombia, averaged approximately 4,250,000 bbl. daily. Some time during 1944 the combined daily average production of these countries is expected to reach 5,600,000 bbl. a day, an increase of 1,350,000 bbl. over 1942. Since the majority of tankers now under construction in this country will have a capacity of 135,000 bbl., the prospective increase in the production of these countries indicates that they will be exporting 10 more tanker loads daily next year than last. If the average wartime-tanker trip requires 1 month, this would mean that these countries alone will need 300 more tankers than they used in 1942.

With 216 tankers completed in 11 months and with the average of the last 2 months being close to 40, it is probable that 1943 deliveries will exceed 250. However, these will include a number of converted Liberty ships and some coastal vessels. Of the 216 completed to the end of November, 44 were converted Liberty ships and 27 were coastal tankers. The former cannot be compared with the standard Maritime Commission tankers which constitute the bulk of the current program, because they are slower and their capacity, 65,000 bbl. is less than half of the standard type. A total of 102 Liberty ships are scheduled for conversion. At the October-November rate of 18 conversions a month they will all be delivered by March.

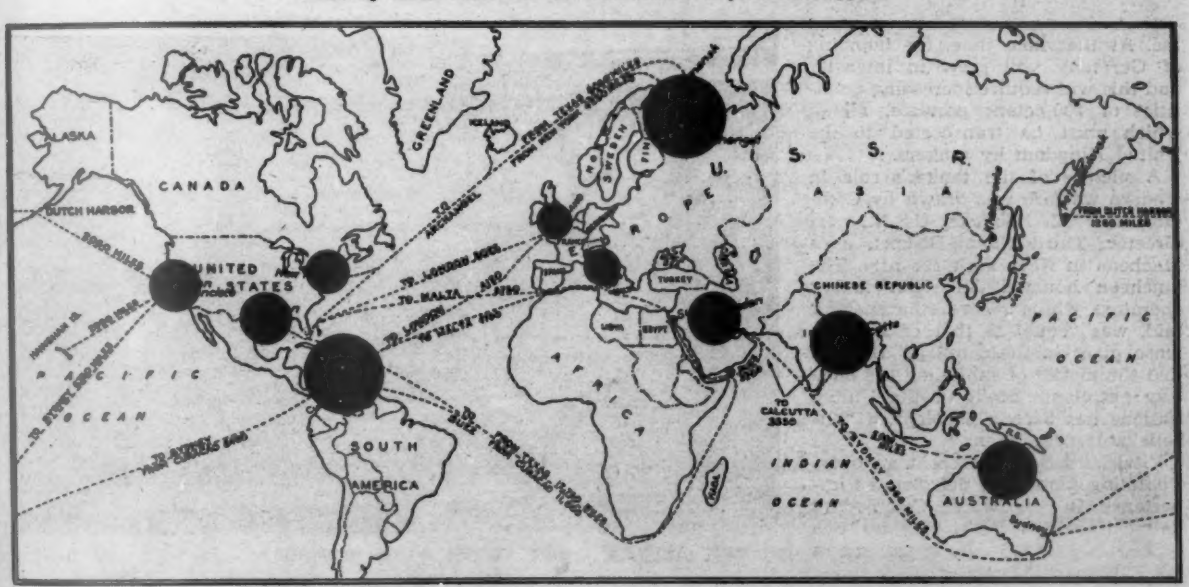
The accelerating rate of tanker construction in this country is apparent from Table 1 showing the monthly totals for 1943.

**TABLE 1—MONTHLY RECORD ON TANKER CONSTRUCTION**

| Month— | Large, high-speed | Converted Liberties | Coastal tankers | Total |
|---|---|---|---|---|
| November | 19 | 17 | 1 | 37 |
| October | 16 | 19 | 5 | 40 |
| September | 14 | 8 | 7 | 29 |
| August | 16 | 0 | 6 | 22 |
| July | 15 | 0 | 1 | 16 |
| June | 11 | 0 | 3 | 14 |
| May | 15 | 0 | 1 | 16 |
| April | 13 | 0 | 3 | 16 |
| March | 12 | 0 | 0 | 12 |
| February | 9 | 0 | 0 | 9 |
| January | 5 | 0 | 0 | 5 |
| Total 11 mos. | 145 | 44 | 27 | 216 |

The 216 tankers completed in De-

***How the important battle zones and Allied consuming centers are linked by tanker lanes with the chief sources of petroleum supplies***



cember this year plus the 62 delivered in 1942 and 2 in December 1941 raises the total since Pearl Harbor to 280. Numerically, this is almost 80 per cent of the United States prewar ocean-going fleet. While that record of 11.7 oil-carrying vessels per month is impressive, it pales in comparison to the program for the ensuing 13 months to January 1, 1945. During that period, the delivery of 381 such ships, an average of almost 30 per month, is scheduled. This will raise the total to 661 since Pearl Harbor.

### Demand Ahead of Building

The increasing tempo of the United Nations offensive indicates that there will be a need for all tankers available, particularly in early 1944 when the invasion of western Europe is expected. The need will be more acute if the invasion of the continent on the west is accompanied by another thrust via the Balkans and by an attempt to drive the Japs from Burma. At the same time, the bombing of Germany will grow in intensity and this will require increasing quantities of 100-octane gasoline, all of which must be transported to the United Kingdom by tankers.

A picture of the tanker's role in modern warfare was drawn by Commodore F. C. Reinicke, U.S.N., port director, Third Naval District, at a luncheon in New York recently. The luncheon honored American tanker operators whose record, the speaker said, was "equal to that of any defense plant in the country." He said that the matter of supplying the military petroleum needs of the United Nations has been a problem of "unbelievable proportions."

Vital statistics "represent an overwhelming picture of petroleum's importance in the war," Commodore Reinicke said. "Let's consider one typical day of all-out operations in the European theater alone. A single bomber requires about 2,000 gal. of aviation gasoline for an average mission over the continent. In one of the nightly raids on such centers as Hamburg, the Ruhr, Cologne and Berlin, an average of 500 bombers will participate, requiring 1,000,000 gal. of gasoline. Light bombers sent over France and the Low Countries on the same night are used to divert the enemy's fighter protection and use up an additional 500,000 gal. of gasoline. During the same night, bombers from Sicily, North Africa and now Italy, are hitting the enemy's backdoor in strong formations burning up another 500,000 gal. Remember this is still only night-time air operations, and we've accounted for 2,000,000 gal. of gasoline already—add to this the great masses of daylight precision bombing forays made by Flying Fortresses, the reconnaissance flights, the fighter protection furnished each bombing mission, the low-flying bombing and strafing sorties and you account of another 750,000 gal. of aviation gasoline.

### Demand Ahead of Building

"So far we've considered only air activity. Within the same 24-hour period much ground activity has been taking place. A medium size tank averages 1 mile to a gallon of fuel. Multiply this by the tremendous daily mileage tanks have averaged in recent operations and multiply that by hundreds, even thousands, of tanks that have been employed in mass movements in any 1 day in, let's say, the African campaign. To this staggering figure add the fuel consumed by supply trucks, jeeps, tank trucks, squad cars, gun carriers, troop carriers, hospital trucks, and all other fuel-consuming vehicles that are involved in logistic or tactical operations and you have a figure the enormity of which is hard to grasp. The petroleum problem, you will agree, is of unbelievable proportions. Without violating security, I can tell you that in one typical day of all-out offensive, the European theater of operations consumed 42,000 tons of petroleum (about 350,000 bbl.).

"To the land and air force requirements of petroleum must be added the demands made by the naval forces. Every convoy that crosses the

*Left: H. C. Bryant, assistant to chairman, tanker control committee, British Petroleum Board; H. B. Heath Eves, chairman, tanker control committee and deputy chairman of Anglo-Iranian Oil Co., Ltd.; Commodore Frederick C. Reinicke, port director, Third Naval District, and R. J. E. Dodds, member, tanker control committee*

*Below: B. B. Howard, general manager, marine operations, Standard Oil Co. (New Jersey), and Capt. L. A. Pucket, chief of the Navy petroleum pool*

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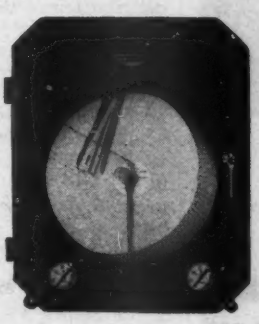

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Atlantic must be protected by corvettes, patrol craft, destroyers or cruisers. In addition to this the regular Atlantic patrols and task forces must be constantly refueled. In the case of aircraft carriers, we not only have the requirements of the ship itself but she must also take sufficient products to fuel her planes. The number of troop landing barges, tank landing barges, PT boats and small craft utilized in the invasion of North Africa, Sicily and Italy, you can appreciate, were numbered in the thousands. All of these craft rely on petroleum for fuel. Considering these thousands of uses for petroleum products along with the virtually world-wide distribution of the Allied users, it becomes evident (even to the most casual lay observer) that there is a vast and constant problem of distribution. A tremendous fleet of tankers is necessary to keep pace with the huge geographic aspects our war efforts has attained. Wherever our fighting forces have penetrated there exists a steady daily demand for petroleum products and in volume proportionate to the quantities I described before.

**Building Overbalances Sinkings**

"Let's take a look at the tanker situation. At the outset of the war there were roughly as many tankers as there are today. In the early days of the war, beginning September 1, 1939, there was a sudden tremendous drop in this number because of torpedoings. Since then a great many tankers have been sunk, but the terrific building program has enabled us to keep pace with these sinkings and now, since May, to forge ahead. We have now reached the time when the average Allied losses of shipping in the Atlantic per month can be counted on the fingers of one hand. . . .

"Encouraging as all this may sound, the task of getting petroleum out to all parts of the world has not been and is not today an easy job. There is a great problem involved of having tankers available in time and at the proper places for convoys. Most of the time this job gets pared down to a precision operation as carefully timed as a crack-train schedule. This requires much personal zeal and endeavor on the part of the commercial operators and oil companies as well as the Navy.

"The machinery for ensuring quick turn around of tankers has been put into smooth operation. However, at all times this has required the complete and immediate cooperation of the oil companies and I want to compliment you and thank you for what each of you has done. Only by virtue of this quick turn-around system has it been possible for us to forge ahead with the limited tankers we have had for our use. Tanker operations have improved so much that whereas formerly one tanker out of

four scheduled for sailing missed her convoy for one cause or another, today only 1 tanker in every 30 scheduled to sail misses her convoy. This is an enviable record, equal to that of any defense plant in the country, and one of which you may be proud."

While it appears, on the basis of Commodore Reinicke's talk, that 1944 will require the services of all available tankers, the need for so many of these vessels after the war is questionable. By that time the United States will be a fleet of possibly 750 to 800 ocean-going tankers, excluding the converted Liberty ships which will doubtless be uneconomic. This would be more than double this country's prewar fleet and would make the United States by far the world's largest tanker operator.

### Factors Governing Disposition

The possible disposition of this war-born fleet is a matter of conjecture. It is probable that it will be governed by the following factors:

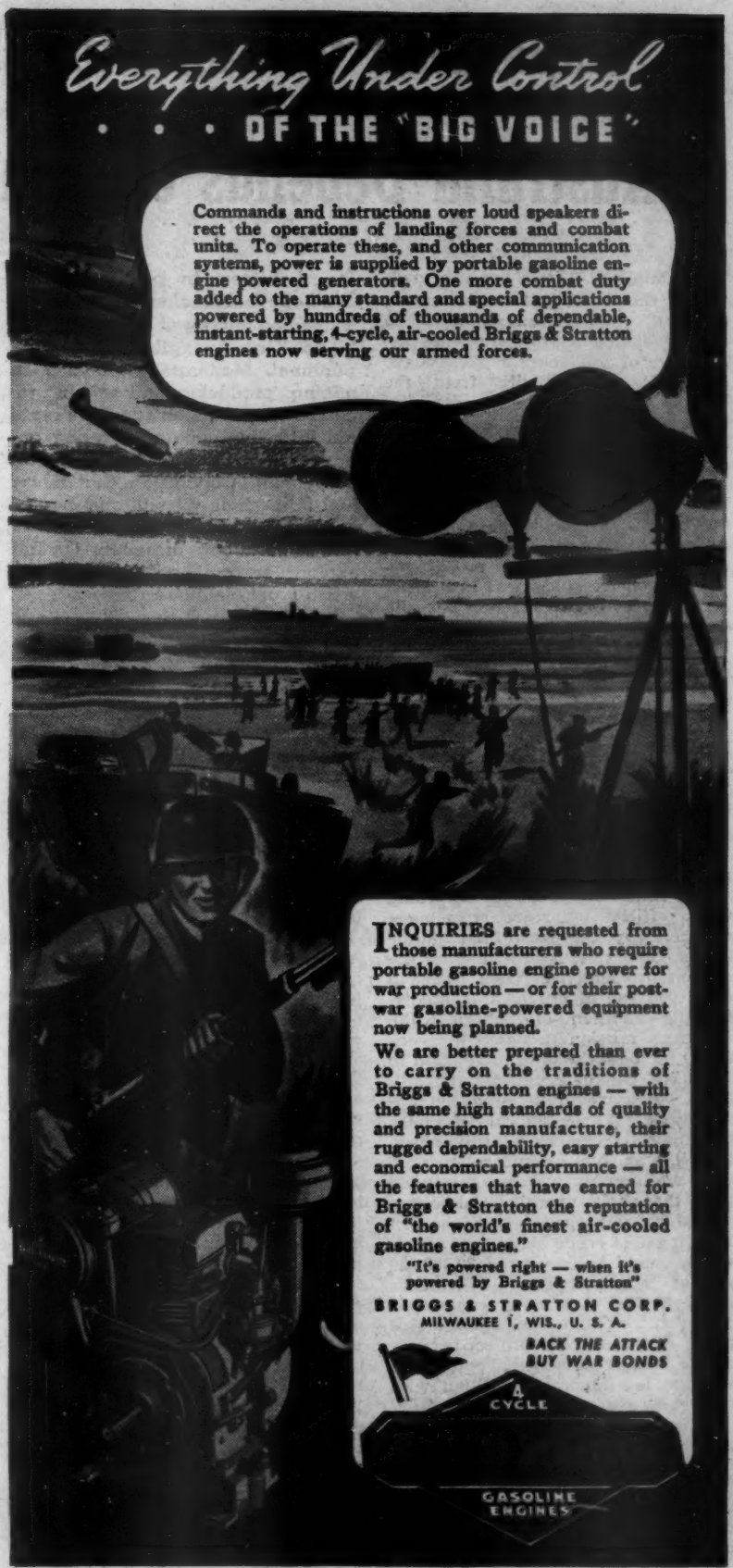
1. World demand for oil is expected to be considerably greater in postwar than in prewar years. Since the major consuming areas are distant from the major producing areas, this will mean a substantially greater need for tankers.

2. At the moment it appears that the United States, the world's greatest consuming country, will find it necessary to resort to more sizable imports. The resultant increase in demand for tanker capacity might be offset entirely if the 24- and 20-in. pipe lines are continued as petroleum carriers since they would replace a considerable portion of the tonnage normally employed coastwise.

3. The tanker fleets of many of the United Nations, particularly that of Norway, have been depleted by losses during the war and vessels built in this country might very likely provide replacements.

4. If there is still a surplus of new tankers remaining, older vessels will undoubtedly be scrapped since the new ones are, on the average, 40 per cent faster and have 40 per cent greater capacity than the old.

Whatever the future holds, American tanker operators can take a justifiable pride in their war accomplishments. Outstanding among their contributions have been the efficient handling of available ships, the development of the design upon which the highly efficient Maritime Commission tanker is based and, possibly most important, the inauguration of a building program long before Pearl Harbor that gave this country a number of large capacity, high-speed tankers that proved invaluable to the United States and Allies between the beginning of the war and the time when the Maritime Commission program began to deliver.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# Expansion of Shale-Oil Industry in Australia Depends on Lend-Lease Aid

**Broad interest in potentialities of synthetic fuels makes this report on a detailed survey of shale-oil possibilities in Australia particularly pertinent. Moderate expansion in mining, producing and refining facilities is dependent on lend-lease aid from this country covering approximately $1,625,000 worth of equipment. Conclusion that motor fuel from shale oil will cost nearly double the price of imported gasoline is a strong argument for full exploration and exploitation of the world's petroleum resources.**

RECOMMENDATION has been made by the Australian parliamentary standing committee on public works that development proceed toward the objective of producing 39,200,000 gal. of crude oil annually from the Newnes-Capertee shale deposits, now more commonly known as the Glen Davis area of New South Wales. The recommendation is qualified on ability to acquire machinery from the United States, under lend-lease arrangements, in the value of 500,000 Australian pounds. (The Australian pound is currently quoted at $3.25.)

An extensive study was made earlier this year of the shale-oil deposits and the project of increasing production of crude oil to approximately 935,000 bbl. annually by a mission of three Americans, representing the Board of Economic Warfare which is currently known as the Foreign Economic Administration. V. V. Jacomini, Houston, Tex., Hudson Engineering Co., was chief of the mission. Other members were H. S. Bell and H. F. J. Hebley.

### American Proposals

The American proposal, according to an official report recently made available by the Australian public works committee, is to accelerate the current production at Glen Davis to 17,000,000 gal. of crude oil annually. By the addition of facilities, the American mission proposed to eventually increase the total production to 39,200,000 gal. of crude oil annually from which would be produced approximately 22,400,000 gal. of motor fuel (petrol), together with diesel oil, gas oil, wax, fuel oil and coke.

In addition, it was recommended that the shale deposit at Baerami should be developed to produce 37,360,000 gal. of crude oil annually from which would be recovered 22,303,920 gal. of petrol, together with other products. The Australian committee, however, recommended against this phase of the over-all project because of the lack of manpower, equipment and the less favorable position with respect to costs.

Investigations made abroad showed that better results might be expected from a type of retort operated in Estonia, and known as the Kivioli retort. Plans of this retort were purchased by Sir George Davis, when he took over the development of the Glen Davis deposit, but the cost of installation was considered too high, and the project was dropped. Subsequently, four of the existing retorts were reconstructed to conform to the type of the original Fell retort, and are giving more satisfactory results; it is intended gradually to reconstruct the remaining 60 retorts in operation to that type. An additional 44 of this type of retort is being erected, and when this work is completed a total of 108 retorts of the Fell type, with four offtakes, will be in operation.

The retort recommended by the American mission for the production of the increased quantity of oil projected at Glen Davis is one developed by Jacomini, and known as the Renco retort. This is said to be capable of operating in units capable of treating as much as 350 tons of shale per day, and will each cost approximately £100,000. It has never, to the committee's knowledge, been operated on a commercial scale, but a smaller model, capable of treating 75 tons per day, has been run for short periods under tests. The result of the test made in Australia showed that the optimum rate of throughput for this particular retort was 50 tons per day, when the efficiency of recovery was 95 per cent of the shales tested. At the rate of 70 tons throughput per day, the efficiency dropped to 79 per cent. The report of experts on this retort was to the effect that they had "every confidence that the retort designed by Jacomini on the sound basic principle developed by him will give satisfactory and efficient service." Nevertheless, the committee is loath to recommend the construction, at a cost of approximately £300,000, of retorts which have not been operated on a commercial scale. However, the retorting is the weakness in the present operation at Glen Davis, and if there can be discovered a retort which will give satisfactory service while extracting a greater percentage of the oil content of the shale, the output, as well as the financial aspect of the venture will be greatly improved.

### Renco Retort Impressive

After discussion with the Commonwealth representatives on the board of directors of the National Oil Pty., Ltd., et al, the committee is impressed with the potentialities of the Renco retort, and considers it should be tried out under working conditions. If a pilot plant were put in at Glen Davis and operated for 3 to 6 months, the company would know much more about it, and either substantiate the claims made for it, or as a result of its work, prove that certain alterations or modifications are necessary. It was ascertained that a unit of the Renco retort which could be installed as an integral part of the existing plant could be established at Glen Davis for a sum of approximately £30,000. This was strongly advocated by one of the directors who is also assistant manager of the steel works of the Broken Hill Pty. Co. at Newcastle, who intimated that there had been discussions with Jacomini in regard to some technical aspects of the operations of the Renco retort, which emphasized the desirability, virtually the necessity, of proving whether Jacomini was right or wrong.

The committee therefore recommends that steps be taken to have a pilot unit of the Renco retort established at Glen Davis at an estimated cost of £30,000 as early as practicable.

Certain essential parts of the Renco retort are not manufactured in Australia, and delay will occur in securing them from the United States. The committee was informed, however, that a boiler, valves, and some other parts of the test retort erected here for experimental purposes have been acquired by various firms in Australia. Unless these firms are using such equipment for essential war work, the committee recommends that consideration be given to the question of impressing such materials for the purpose of constructing the pilot plant at Glen Davis, and so save the

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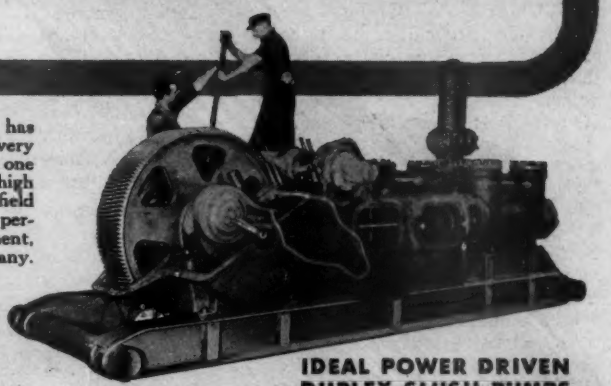

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| Type | Standard Liner Bore, Inches | Smaller Liner Bores, Inches | Stroke, Inches | Revolutions Per Minute | Horsepower Ratings | | Working Pressure |
|---|---|---|---|---|---|---|---|
| | | | | | Brake Input | Hydr. Output | |
| D-50 | 5 | 4½, 4, 3½ | 10 | 60 | 60 | 50 | 1000 |
| C-100 | 6¼ | 5¾, 5¼ | 10 | 65 | 120 | 100 | 1500 |
| C-150 | 6¾ | 6¼, 5¾, 5¼ | 12 | 65 | 180 | 150 | 3000 |
| C-250 | 7¼ | 6¾, 6¼, 5¾, 5¼ | 15 | 60 | 300 | 250 | 2500 |
| C-350 | 7¾ | 7¼, 6¾, 6¼, 5¾, 5¼ | 18 | 55 | 420 | 350 | 3000 |

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| Type No. | Nominal H.P. Rating | Nominal Drilling Depth* Feet | Nominal Drilling Depth* Drill Pipe | Slush Pumps | Complementary Ideal Equipment: Rotary | Swivel | Connector | Traveling Block | Crown Block |
|---|---|---|---|---|---|---|---|---|---|
| 30 | 100 | 3,000 | 3½" | C-100 | FE-12½ | L | D-6 | D-6 | D-6 |
| 40 | 150 | 4,000 | 4½" | C-100 | FE-17½ | L | D-6 | D-6 | D-6 |
| 50 | 350 | 5,000 | 4½" | C-150 or C-250 | FE-12½ or FE-17½ | L or P | D-12 | D-12 | D-12 |
| 75 | 500 | 7,500 | 4½" | C-250 or C-350 | MS-20½ | DF or D | D-20 | D-20 | D-20 |
| 100 | 650 | 10,000 | 4½" | C-250 or C-350 | SHS-20½ or MS-20½ | R-3 | D-20 or DA-30 | D-20 or 548-T | D-20 or 648-T |
| 150 | 950 | 12,500 | 4½" | C-350 | SHS-20½ | R-3 | DA-30 | 548-T | 648-T |

*Greater drilling depths are obtainable with smaller drill pipe. 4½" ratings shown are very conservative.

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|---|---|---|---|---|
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| FE-17½ | 17½ | 44 or 53½ | 5000–4½" | |
| MS-20½ | 20½ | 53½ | 15000–4½" | |
| MS-27½ | 27½ | 53½ | 15000–4½" | |
| SHS-20½ | 20½ | 53½ | 15000–4½" | |

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time that would be lost in awaiting importation.

To reach the proposed output of 17,000,000 gal. of crude oil, giving 9,350,000 gal. of petrol per annum, about 1,000,000 gal. of water per day will be required; while to develop the scheme outlined by the American mission, to 39,200,000 gal. of crude oil, about 1,250,000 gal. of water per day will be necessary.

The following pertinent highlights are excerpts from the Australian public works committee report:

### Estimated Cost—Glen Davis

The estimated cost of the additional plant and capital required, as set out by the American mission, is:

| Facilities— | Australian pounds |
|---|---|
| Additions to mining plant | 156,000 |
| Additions to crushing and conveying plant | 75,000 |
| Additions to retorting plant | 300,000 |
| Added refining plant: Topping unit, catalytic cracking unit, coking unit, wax plant, storage | 537,000 |
| Housing | 50,000 |
| Total | 1,118,000 |

Of this amount, it was explained in evidence that it was expected that the U. S. Government would make available under lend-lease agreement, machinery to the value of £500,000, so that the actual amount required to be made available by the Commonwealth would be £618,000.

### Baerami

For the opening up of the Baerami deposit, it was estimated that the requirement would be:

| Facilities— | Australian pounds |
|---|---|
| Mine equipment, crushers, trucks, road, shop, etc. | 620,000 |
| Retorts, spent shale disposal, etc. | 600,000 |
| Power house for mine and retorts | 100,000 |
| Water supply | 100,000 |
| Pipe line | 87,000 |
| Refinery | 669,000 |
| | 2,176,000 |
| 10 per cent war contingencies | 218,000 |
| | 2,394,000 |
| Mine development | 220,000 |
| Self-liquidating capital for village | 300,000 |
| Total capital required | 2,914,000 |

Of this amount, it was expected that the U. S. Government would make available under lend-lease agreement, the sum of £600,000, so that the total amount to be made available by the Commonwealth would be £2,314,000.

### Estimated Revenue—Glen Davis

While the project, as proposed, is said to be capable of attaining a 62 per cent yield of petrol (24,329,000 gal.) per annum, from the crude oil, it is realized that the disposal of the fuel oil in excess of the plant requirements, may be a problem, excepting when it is required by the naval and military forces. For purposes of analysis, an example of diversification of salable products was offered as an average of what may be expected. This was given by the mission as:

**VALUE OF PRODUCTS AT 1942 PRICES**

| | % | | s. d.* | Australian pounds |
|---|---|---|---|---|
| Petrol | 57.1 | 22,400,000 gal. | 1 4.7 | 1,558,667 |
| L.C.T. diesel | 7.5 | 2,940,000 gal. | 6.5 | 79,265 |
| Gas oil | 7.1 | 2,780,000 gal. | 4 | 46,333 |
| Wax | 3.5 | 12,000,000 lb. | 5 | 250,000 |
| Fuel oil | 13.7 | 5,370,000 gal. | 3 | 67,125 |
| Coke | 1.5 | 2,600 tons | 34 0 | 4,420 |
| Annual value of products | | | | 2,005,810 |
| Less operating costs— | | | | |
| Mining | | | | 346,000 |
| Crushing | | | | 22,400 |
| Retorting | | | | 200,800 |
| Refining | | | | 250,000 |
| | | | | 819,200 |
| Net annual realization before charges for interest, taxes and amortization | | | | 1,186,610 |

*Price per gallon.

### Baerami

The refining plant is designed for operations varying from that of maximum production of petrol to maximum production of fuel oil, either of which operations may be demanded by the naval or military forces. For the purpose of analysis, an example of diversification of salable products was offered as an average of what may be expected. This was given by the mission as:

**VALUE OF PRODUCTS AT 1942 PRICES**

| | % | Gallons | s. d.* | Australian pounds |
|---|---|---|---|---|
| Petrol | 59.7 | 22,303,920 | 1 4.7 | 1,551,981 |
| Diesel oil | 1.2 | 448,320 | 7 | 13,076 |
| Gas oil | 19.3 | 7,210,480 | 4.5 | 135,196 |
| Fuel oil | 9.5 | 3,549,200 | 3 | 44,365 |
| Annual value of products | | | | 1,744,618 |
| Less operating costs— | | | | |
| Mining | | | | 672,750 |
| Crushing | | | | 22,425 |
| Retorting | | | | 72,000 |
| Pipe line | | | | 8,400 |
| Refining | | | | 180,000 |
| Total | | | | 955,575 |
| Net annual realization before charges for interest, taxes, amortization and Crown royalties | | | | 789,043 |

*Price per gallon.

### Committee's Investigations

All witnesses agreed that for the present, efforts should be concentrated on increasing production at Glen Davis, as it was unlikely that men and material could be obtained for the development of the project at Baerami, which, in addition to mining machinery, refining plant, power house, etc., involves also the construction of a village, road, pipe line, water supply, etc., for an entirely new venture. Consequently, beyond preliminary inquiries, the committee has confined its attention to Glen Davis, and this report refers wholly and solely to that project.

### Extent of Deposit

It was ascertained from the senior geological surveyor of the Department of Mines, New South Wales, who made a survey of the area, that the Capertee-Wolgan field which includes Glen Davis and Newnes, covers about 20 sq. miles. The known deposit would allow of the treatment of 575,000 tons of shale per annum over a period of 15 years. In addition, experts report that there is a considerable quantity of shale in the immediate vicinity which could be treated at the Glen Davis plant.

### Quality of Shale

The rich seams at Glen Davis have an oil content of over 100 gal. to the ton, while some of the other seams are of lower value. From "run of the mine" treatment the American mission plans to extract an average of 68.2 gal. of crude oil per ton. It was ascertained in evidence that the material treated at Glen Davis during 1941 had an oil content of 95 gal. to the ton, and the recovery was 58.8 gal. per ton.

### Retorts

All the processes associated with the production of petrol at Glen Davis are in operation successfully, excepting the vital one of carbonizing the shale. It is claimed that this is due to the unsatisfactory type of retort in use, and the lack of an adequate water supply.

The question of retorts has been the subject of much inquiry. The efficiency of a retort is dependent on the quality of the shale treated, and the amount of material dealt with per day. Many retorts which in the laboratory stage give excellent results, have proved disappointing when operated under commercial conditions.

The first type of retort established at the old Newnes works was what is known as the Pumpherston retort, which for many years had been operated in Scotland. The Scottish shale, however, is of low oil content, and this type of retort was soon proved unsatisfactory for the treatment of the higher grade Newnes shale. Improvements were made by constructing four offtakes of gases and better results were obtained. This became known as the Fell retort. Subsequently, this retort was modified, and reverted to the single offtake, and the results obtained were not so satisfactory.

### Present Volume of Production

The production of oil at Glen Davis commenced about the middle of 1940. In 1941 the amount of crude oil produced totaled 4,273,315 gal.; for the first 6 months of 1942, production was

1,622,518 gal., and for the second half of the year, production was 2,099,253 gal., a total of 3,721,771.

Petrol manufactured in 1941 totaled 1,999,018 gal., and in the following year 1,559,823 gal.

The cost of producing petrol at Glen Davis during 1941, including interest and depreciation, was 3s. 3.054d. a gallon.

### Sale Price

After duly considering the question of distributing its own petrol, and deciding that the cost of doing so would be too heavy, the company entered into an agreement with the major oil companies under which Pool Petroleum Pty., Ltd., agreed to take the total production from Glen Davis, at a price calculated on the weighted average landed cost of importations in all Australian capital cities. The price is arrived at monthly, and has varied from 1s. 9d. to 1s. 11.663d. a gallon.

### Commonwealth's Return From Investment

The question was raised in committee as to whether, under existing circumstances, the financial interests of the Commonwealth in this company are being sufficiently safeguarded. Under the agreement ratified by the National Oil Pty., Ltd., Agreement Act, 23 of 1937, the Commonwealth was to loan to the company £334,000 as against £166,000 loaned by the State of New South Wales, and £166,000 provided by the National Oil Pty., Ltd. The commonwealth and state loans were to be repaid over a period of 20 years, with interest at the rate of 4½ per annum. Since then, the commonwealth has provided additional funds, bringing its contribution to £1,300,000, and the company has brought its share up to £325,000, the state's loan remaining at its original figure. To bring production up to approximately 10,000,000 gal. of petrol per annum, the commonwealth has agreed to provide an additional sum of £1,137,634, bringing its commitments to £2,437,634.

### Anticipation and Achievement

The Newnes investigation committee, in 1934, after an inquiry extending over some months, submitted a report, picturing a prosperous future for Glen Davis, which, unfortunately, has never eventuated. The anticipation of that committee was that a company with an initial capital of £600,000 would be able to produce annually 6,000,000 gal. of motor spirit and 19,000 tons of fuel oil; sell these products at 11½d. a gallon, and £2 13s. 6d. a ton, respectively, and pay to shareholders a dividend of 6 per cent per annum. After nearly 3 years' operation, the position now is that the capital of the company is £1,800,000, petrol is being sold at 1s. 9d. to 1s. 11d. a gallon, and the company, during 1942, made a loss of approximately £260,000.

### How This Project Is Viewed

During the course of its inquiries, it was increasingly borne in on the committee that this project could not be considered from the ordinary commercial standpoint, but must be regarded from a national point of view. The committee has formed a definite conclusion that petrol of a satisfactory quality can be produced from Glen Davis shale, but the cost, having regard to the loss of customs revenue, would be at least twice that of imported petrol. On economic grounds, the establishment of an industry is not warranted, and it could be justified only on the importance for national considerations of developing an Australian oil industry. The extent to which Australia can afford to exploit its own oil resources at this cost must depend upon national policy.

Although the American mission has painted a rosy picture showing that when Glen Davis attains the production of 9,350,000 gal. of petrol per annum it will, on 1942 prices, have a net annual realization of £241,990, before charges for interest, taxes and amortization are deducted, the fact must not be lost sight of that a representative of the company stated he considered it would be 5 years before production reached 9,350,000 gal. Moreover, petrol prices are unlikely to remain at their present high rate after the war, and "interest, taxes and amortization" are more than likely to be in excess of the £241,990 mentioned.

The proposal to increase production to 22,400,000 gal. of petrol per annum, visualizes the retorting of 1,260 tons of shale, 24 hours a day, for 365 days in the year. As, under the best circumstances, with A1 priorities in all departments, it is unlikely that the machinery can be available within 6 months, and it is expected that production will be reached 18 months after that, it will be seen that the possibility of full production under both the present and the proposed plan can be of little assistance to the war effort unless the war is to drag on for more years than we like to contemplate.

Nevertheless, taking the long view, it will be an advantage if, at some time in the future, this company will be in a position to produce approximately 5 per cent of Australia's petrol needs. Moreover, employment will be given to a substantial body of men, and the experience gained in this proposition may lead to the exploitation of other shale seams which are known to exist in other parts of the commonwealth, and the possible extraction of oil from coal, when the demand for coal, as coal, diminishes, as some people are inclined to think.

### Conclusion

After due consideration of all the circumstances, the committee recommends that provided machinery to the value of £500,000 is supplied under lend-lease agreement arrangements be made to obtain the equipment necessary for the development of Glen Davis for the production of 39,200,000 gal. of crude oil per annum, to produce 22,400,000 gal. of petrol per annum, but that the order for Renco retorts be not decided upon, pending receipt of reports that the pilot plant to be installed at Glen Davis has proved that the Renco retorts will be satisfactory.

### Progress Reports

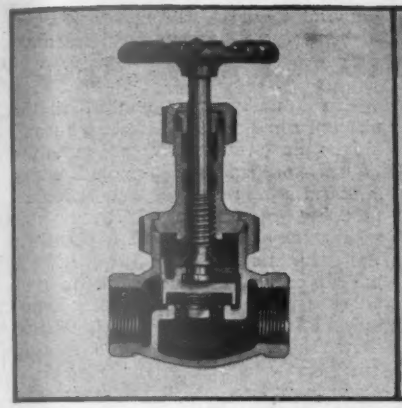
In order that the Commonwealth Government may be kept fully informed of the development at Glen Davis, the committee recommends that the minister in charge be furnished with a progress report at least quarterly, setting out the work done in the installation or alteration of plant, etc., and also particulars of the production of petrol, oil, etc., and the prices received for them.

### Total Capital Cost

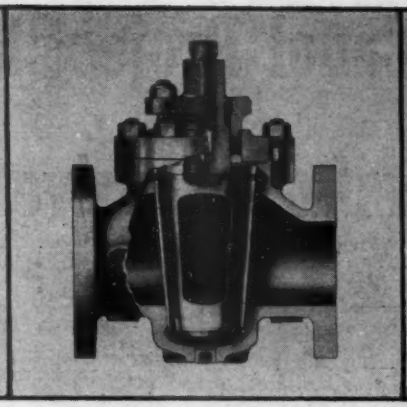
The following summary shows the total capital cost at Glen Davis when these proposals shall have been carried into effect:

| | Australian pounds |
|---|---|
| As stated in paragraph 7 of this report, the capital advanced by the commonwealth up to date is | 1,300,000 |
| To enable the output of petrol to reach the figure of 9,350,000 gal. of petrol per annum, the commonwealth has already approved of the expenditure of an additional | 1,137,634 |
| Since then it has been estimated that the Fish River water-supply scheme will require an additional commonwealth contribution of | 239,537 |
| To increase petrol production to 22,400,000 gal. per annum, as proposed by the American mission, it is estimated to require (of which sum it has been stated the U. S. Government will provide machinery under the lend-lease agreement to the value of £500,000.) | 1,118,000 |
| The total capital advanced by the commonwealth at Glen Davis will then amount to | 3,795,171 |
| In addition, the New South Wales Government has advanced | 166,000 |
| And the National Oil Pty., Ltd., has invested | 325,000 |
| | 491,000 |
| Making the total capital in the venture | 4,286,171 |

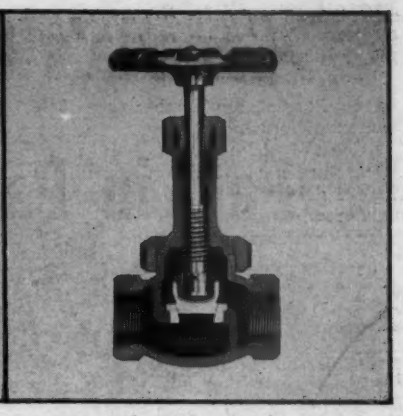
The statement shows that under the committee's recommendations it is expected that the production of petrol at Glen Davis will be increased from 9,350,000 gal. per annum to 22,400,000 gal. per annum, at an additional cost to the commonwealth of £618,000.



WALWORTH FIG. 95 BRONZE GLOBE VALVE



WALWORTH LUBRICATED PLUG VALVE



WALWORTH FIG. 225-P 500 BRINELL GLOBE VALVE

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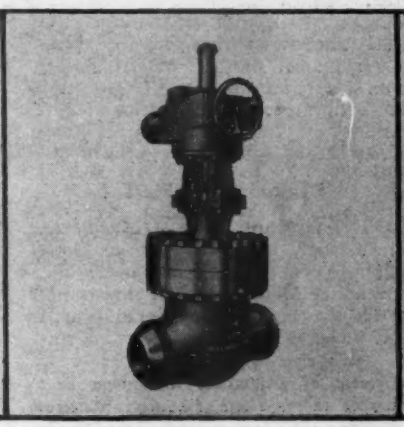

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# Canada's Canol Project May Play Part in Pacific Offensive Strategy

*by Victor Lauriston*

UNDERTAKEN originally in the dark days immediately after Pearl Harbor to provide a source of oil supply for menaced Alaska safe from submarine or bombing attack, the Canol project in the Canadian Northwest has been continued as a potential source of fuel supply for a direct attack on Japan from the far-reaching Aleutians, once more wholly under the Stars and Stripes.

The solution of this strictly military problem lay in an oil field, and communications, sufficiently far inland to be relatively safe from bombing, and which could be protected by land-based fighters.

The Fort Norman field, in Northwest Canada, on the Mackenzie River, just south of the Arctic Circle, was the only field sufficiently proven by drilling and geological investigation to give definite promise of the production imperatively needed. It had four advantages, apart from its purely strategic advantages of location. Geological investigation has indicated a large potential field; the comparatively shallow drilling promised quick development; the oil was relatively high grade; and its pour point around 70° below zero, gave promise of successful pipe-line transmission at practically all seasons of the year.

### Beginnings of Field

Oil occurrences on the Mackenzie River had been noted as long ago as 1789 by the explorer, Sir. Alexander Mackenzie, but it was not until just before the World War I that steps were taken toward development. In 1914 a Canadian syndicate sent a party under Dr. T. O. Bosworth who examined the structures, staked acreage, and located No. 1 well.

The war interrupted the project, but about 1918 Imperial Oil, Ltd., took over the acreage and secured Dr. Bosworth as chief geologist. The Fort Norman development became part of Imperial's great oil-development campaign in western Canada, which has continued ever since.

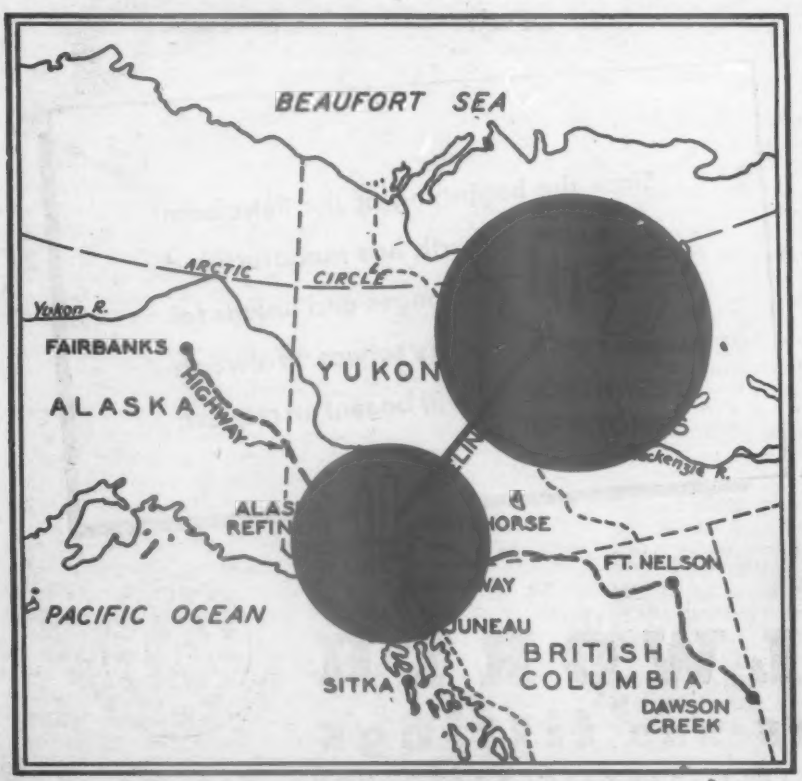
In the short navigation season of 1919 equipment was taken in, a crew in charge of Dr. T. A. Link, now chief geologist for the company, wintering in the North for the sake of an early start in the spring. The 1 Northwest Co. (Imperial), drilled on the east side of the Mackenzie at the mouth of Bosworth Creek, in 1920 struck a flow, estimated 100 bbl. a day, at 783 ft. Production came from the Fort Creek shales which later caved, cutting off the flow. In 1922 the well was deepened to 951 ft., obtaining 60 to 70 bbl. a day; and in 1923 further deepening to 1,025 ft. stepped it up to 100 bbl.

News of the strike, in the fall of 1920, started a boom, in which numerous oil companies were launched, but only one, Fort Norman Oil Co., got to the drilling stage. Its No. 1, drilled in 1921 about 8 miles upstream (south) from the discovery well, on the east bank, reached 1,512 ft., getting 300,000 cu. ft. of gas between 385-500 ft. but no oil.

Meanwhile, Northwest Co., the Imperial subsidiary, continued development. Its Bluefish well, on the east bank downstream from Great Bear River, was abandoned owing to drilling difficulties. "C" well, drilled in 1921-22, on the west bank, completed dry in the Beavertail limestone at 3,057 ft. "D" well on Bear Island, south and west of No. 1, got a small show at 1,945 ft. and salt water at 2,060 ft., being abandoned at 2,304 ft. Northwest 2, offsetting the discovery 150 ft. drilled in 1924-25, finished at 1,602 ft. with oil production at 936 and 1,063 ft. estimated 110 bbl. a day.

In 1925, with the field proven to this extent, Imperial capped its wells and discontinued operations.

***Where the U. S. Army has sponsored development of production, built pipe lines and constructed a refinery in the northwestern part of the North American continent***



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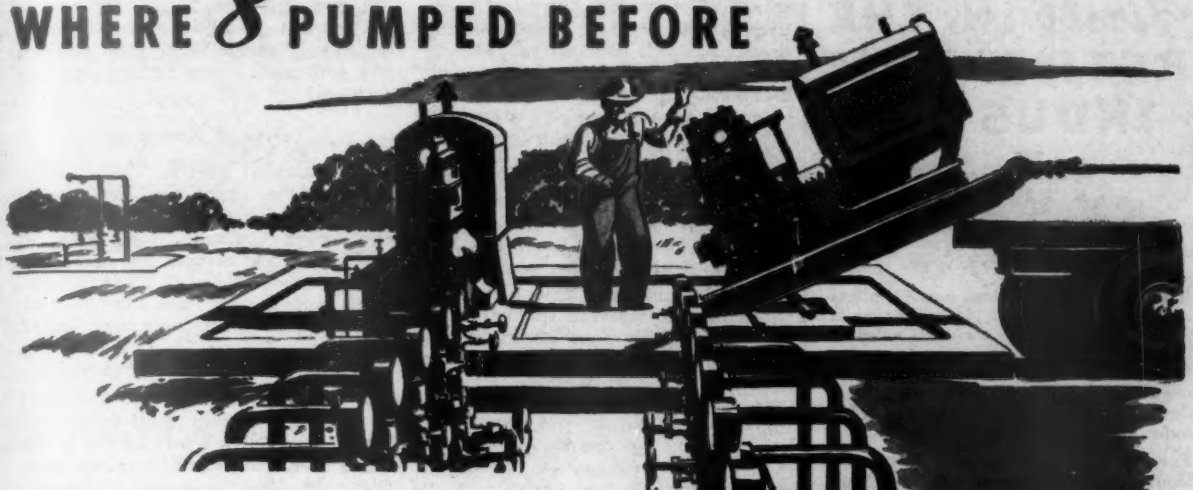

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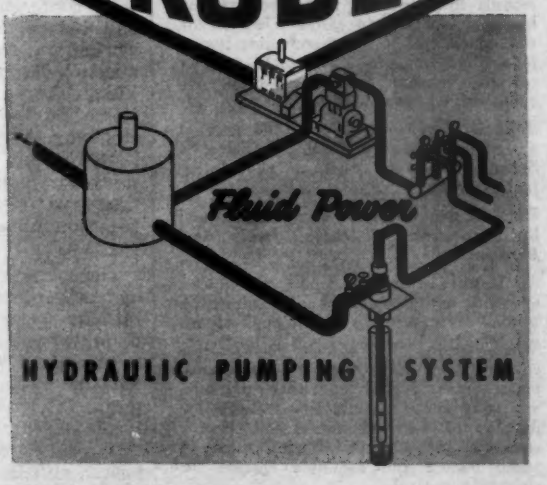


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In 1932 the fuel requirements of the radium-mining operations at Great Bear Lake led to the reopening of the field, and the construction of a small refinery, to produce gasoline for river boats and fuel oil for mine machinery. In 1937 the gold development at Yellowknife furnished a further outlet. At least one additional producing well was drilled. The refinery operated in the summer months, building up sufficient reserves to meet the year's demands. In 1939 an 840-bbl. straightrun refinery was built producing not merely fuel oil and motor gasoline but 87-octane aviation fuel.

This fuel was needed to meet the requirements of airplanes used more and more extensively in northern travel. Incidentally, it was Imperial Oil which, to provide quicker communication with Fort Norman, pioneered this form of transportation in the Canadian Northwest.

In 1941, the year of Pearl Harbor, Imperial distributed from the Fort Norman field some 80,000 gal. of aviation gasoline, 112,000 gal. of motor gasoline and 230,000 gal. of fuel oil all told, approximately 12,000 bbl. But, for northern needs, the price of gasoline at the refinery had been cut from $2 to around 30 cents a gallon.

### An Emergency Measure

Pearl Harbor, and the swift rush of Japanese conquest in the Pacific, confronted military strategists on the North American Continent with an emergency. For the defense of Alaska, two things were needed; a road to that outpost territory, and a fuel source independent of tanker transportation. Norman Wells, as the only proven oil field in the Northwest, acquired vast military importance.

In conferences at Washington in and before April 1942, plans were worked out for a pipe line from Norman Wells across the Mackenzie-Yukon Mountain Divide to White Horse, on the then projected Alaska Highway. At one end of this line, the Fort Norman field would be intensively developed; at the other a refinery would process the oil for distribution up and down the Alaskan coast.

The necessary contracts and agreements were executed at Washington in May 1942. It was then that the name "Canol project" was coined by telescoping "Canadian" and "oil." Participants in the contracts were Imperial Oil; Standard Oil Co. of California; J. Gordon Turnbull and Sverdrup & Parcel (as architect engineers), and Bechtel-Price-Callahan as constructors. Carrying out of the contracts was to be supervised by the U. S. Corps of Engineers with Col. Theodore Wyman, Jr., in charge.

A control base was established within a week at Edmonton, Alta.; whence 2,500 United States engineers were dispatched to the end of steel at Waterways, on the Athabaska. At the same time there went north some 15,000 tons of pipe for the line from Norman Wells to White Horse. Additional drilling equipment was also shipped into the North, for a first task was to establish, as quickly as possible, that the field could produce the amount of crude oil the pipe line required.

### Terms of Agreement

A statement of Hon. W. L. Mackenzie King, the Canadian premier, released by Dr. Hugh Keenleyside of the external affairs department at Ottawa, discloses that the first formal proposal from the U. S. Government came in note form June 27, 1942, and the Canadian Government agreed in a note of June 29. The proposals were that the U. S. Government:

1. Construct a pipe line sufficient to deliver 3,000 bbl. of oil daily from Norman Wells to White Horse, a distance of 450 to 460 miles as the crow flies;

2. Sign a contract with a Canadian company to drill additional wells, the U. S. Government to provide equipment and purchase the total flow of the additional wells, the wells to remain part of the property of the company;

3. Arrange for a refining capacity of 3,000 bbl. a day at White Horse;

4. Contract with a company or companies for storage of oil produced at Norman during 1942 in excess of the requirements of the Mackenzie district and for operation of the White Horse refinery unless it should be operated by the U. S. Government.

The Canadian Government was asked to:

1. Acquire any necessary land and rights-of-way and hold the title;

2. Waive import duties, sales taxes, license fees or other charges on equipment or personal effects of construction personnel during the war;

3. Remit during the war royalties on oil production and income tax on persons and corporations resident in the United States who were employed on the project;

4. Facilitate admission to Canada of any United States citizens to be employed on the project during the war.

A pipe line from White Horse to Skagway is a supplementary project, designed to carry gasoline brought to Prince Rupert, B. C., by tank car and thence up the coast to Skagway by barge for the use of the U. S. Army. Started under a verbal agreement of June 26, the formal exchange of notes took place August 14-15, 1943. These notes make the terms of the Canol agreement applicable to the supplementary project, except that storage and loading facilities at Prince Rupert

shall remain U. S. Government property for the duration and be operated under contracts with the U. S. Government.

It is also stipulated that at the end of the war the two governments, at the request of either, shall negotiate regarding disposition of the Skagway-White Horse pipe line and storage and loading facilities at Prince Rupert, no facilities to be dismantled without a recommendation of the Canada-U. S. Defense Board.

Regarding the major Canol project, the U. S. Government is to construct, own and operate it for the duration. Thereafter the properties are to be valued and the Canadian Government is to have first option of purchasing pipe line and refinery at the commercial valuation. Here, also, installations are not to be dismantled by the Canadian Government or any other purchaser without approval of the Canada-U. S. Defense Board.

### Basic Difficulties

The Canol project will, it is estimated, cost around $130,000,000. A striking feature, unusual in oil development is that, on account of the peculiar difficulties encountered, probably a major part of the outlay necessarily went for preparatory work, before delivery of oil could be commenced.

Prior to the advent of the airplane in northern transportation, the northern rivers formed the highways of commerce. The rivers begin to clear of ice about June 1, and are again frozen early in October; but at Fort Norman the navigation season usually extends from late in June till the end of September. In this period, less than 3 months, all heavy supplies must be moved.

Over the river route, equipment and supplies, transferred by rail from Edmonton 300 miles to Waterways, are moved by boat or barge 285 miles down the Athabaska and Slave rivers to Fort Fitzgerald, over a 16-mile portage past rapids, then down the Slave 190 miles to Great Slave Lake; thence 125 miles across the lake to the upper reaches of the Mackenzie, and 550 miles down that stream to Norman Wells, 75 miles south of the Arctic Circle.

Existing transportation facilities on this route capable of handling perhaps 10,000 tons in a season, had to be supplemented by the building of boats and barges capable of stepping up the first season's shipments to around 40,000 tons.

The 16-mile portage between Fort Fitzgerald and Fort Smith was the trail's worst bottleneck. Over this, 100, 200 and 300-ton barges were trundled. Caterpillar tractors handled vast quantities of freight.

For quicker transport of more essential materials, new airfields were established, to enable planes of the Canadian Pacific Air Lines to land without pontoons or skis.

Canol Camp was established on the west bank of the Mackenzie, approximately opposite and about 5 miles distant from Norman Wells. From this point a beginning was made on the eastern end of the Norman-White Horse pipe line.

### Unchartered Wilderness

While the Mackenzie water route was well known, the terrain west of the Mackenzie, extending to the Alaska Highway, was literally an uncharted wilderness. Joseph Keele, a Canadian Government surveyor who traversed it in 1907-8, had left a report and a rough map which, however, gave little more than the most elementary information regarding the 460 crow's-flight miles the pipe line had to traverse.

It was early decided that pipe-line construction must be carried on from both ends. At the Norman Wells end, however, drilling equipment had the right-of-way, and at the end of the first season some 9,000 miles of pipe still lay piled at the Slave River Delta. At the White Horse end, freight for the Alaska Highway clogged the only port of Skagway; and it was not till August, that arrangements could be made to bring in supplies, equipment and pipe via Prince Rupert and Skagway over the 110-mile White Pass & Yukon Railway to White Horse. Camps were set up at Prince Rupert, Skagway, Carcross and White Horse, and by October pipe was being strung and welded for the Alaska Highway lateral line.

In the meantime, a pipe line had been laid across the Mackenzie from Norman Wells to Canol Camp where the engineers were building log cabins and cutting firewood as provision against winter. Storage tanks were well advanced, to take care of the output of newly drilled wells; and when the freeze-up began in October nearly all the boats and barges were safely berthed.

With the advent of winter, a new undertaking developed: the building of a winter road from Peace River, the alternative end of steel 310 miles north of Edmonton, to the Mackenzie. The engineers went to work, the construction gangs followed, and by December truck convoys and tractor trains were moving freight over this new road, to meet other construction gangs moving from the north. Traffic moved over this new road to Canol Camp till early in April, when the spring mud baffled further traffic for the time being.

In December the Canol project was placed under direction of the Northwest Service Command headed by Brig. Gen. James A. O'Connor. In March Colonel Wyman, transferred to another post, was replaced in immediate charge by Brig. Gen. L. D. Worsham as division engineer, U. S. Engineers.

### Routing the Pipe Line

The winter of 1942-43 afforded the first opportunity to select a route for the Norman-White Horse pipe line. True, the 22 hours of midsummer daylight had dwindled to 2 hours, and as tests of human endurance, black flies, mosquitos and heat had given place to glaring snow and subzero temperatures that at times dropped to 70 below. But at no other season could relatively safe footing be assured.

It is stated that, in the course of the winter, seven different expeditions, with ponies, dog teams or on foot, left White Horse to blaze a route to Norman. Six of them had to turn back, baffled by the terrain and the weather. The seventh fought through, locating a route that was far from a bee line, but that took advantage of every favorable feature.

Along this route followed the road-construction gangs, for a road was necessary to move the pipe and equipment. Then came the stringing and welding and laying of the pipe.

It is expected that the pipe line will be completed by January 1, 1944. No information has been given out as to the dimension of pipe used, except that it is "inch" pipe — that is, less than 12-in. diameter. The necessary pumping stations have been set up.

No two reports seem to agree as to the length of the Norman-White Horse line. It is, apparently, somewhere between 550 and 600 miles, the extra pipe required to follow a somewhat roundabout route being more than offset by the saving in labor through taking advantage of favorable natural conditions, such as following the natural drainage lines. Along these lines, conditions are determinable by observation. No one can tell, except through costly experience, what perils underlie the muskeg or tundra.

The refinery at White Horse, a reconstruction of a dismantled refinery from Corpus Christi, Tex., is scheduled to be in operation by May 1944.

### Results of Drilling

The number and location of the wells drilled, and the individual and aggregate production figures are closely guarded secrets. From the outset of the Canol project, a rigid censorship was clamped down on everything connected with it, until about the middle of 1943, when the first releases of information were made public. Even now, only the most general information as to the results of the drilling operations has been given out.

When the undertaking was first mooted, Imperial Oil officials were not too optimistic as to the ability of

the field to supply the pipe-line requirements; though in view of their detailed investigations of the structure they were reasonably hopeful.

Oliver B. Hopkins, chief geologist of Imperial Oil, is authority for the statement that on July 17, 1942, the first new well was drilled in and that by January 1943 new producing wells had met the Army's original oil requirements.

### 26 New Wells Completed

A progress report accompanying Premier King's statement of November 19 stated that 26 new wells had been completed by Imperial Oil in connection with the Canol project. Of these, 23 found oil, and, with four producers drilled prior to the Canol agreement, made a total of 27 producers. Under the United States contract, four wells were drilled outside the Norman field a considerable distance from the producing area, and three on the edges of the area. As only three dry holes were reported, this would leave four new producers outlying the field. The statement further estimates that by July 1, 1943, enough new wells had been drilled to produce 3,000 bbl. daily, and potential production had considerably increased since then.

The 1 Northwest Co. discovery well of 1920 is still in production, indicating that the field may have a fairly long life. The recent wells are stated to be shallow compared with those of Turner Valley, varying from 1,200 to 2,100 ft. Production comes from two main horizons in the Devonian limestone. No information is available as to whether there is any variance in quality in the oil from the later wells. Analysis of the 36 B. crude from the discovery well in 1920 showed specific gravity 0.845 with the following constituents:

| | |
|---|---|
| Gasoline (70° to 150° C.) | 21.5 |
| Illuminants (150° to 300° C.) | 38.5 |
| Light lubricants (300° to 350° C.) | 33.9 |
| Medium lubricants (350° to 375° C.) | 4.1 |
| Loss | 1.0 |

The field has unquestionably exceeded early expectations, and the possibility is forecasted that it may develop into a major field. Washington reports of November 23 quote Robert P. Patterson, undersecretary of war, as stating that "20,000 bbl. a day is now assured, and we have already uncovered an estimated pool of 50 to 100 million barrels." At the lower figure of 3,000 bbl. a day the field would be the largest in Canada outside Turner Valley, which averages around 25,000 bbl. daily. It is the only Devonian field in western Canada.

No official production figures on Fort Norman have been issued by the Dominion Bureau of Statistics since June. Prior to that time, the monthly reports showed a marked increase over the preceding year. Following is the output in barrels:

| | 1942 | 1943 |
|---|---|---|
| January | ..... | 9,107 |
| February | 129 | 11,556 |
| March | ..... | 17,374 |
| April | 2 | 19,692 |
| May | 15 | 14,796 |
| June | 9,528 | 17,402 |
| Total (6 mos.) | 9,674 | 89,929 |

It was in June 1942 that increased demand afforded a steady market for the output of the field's original three producers, enabling them to be operated to capacity. Subsequent increases reflect the increased potential of the field, though of course the output recorded was limited by lack of storage and marketing facilities. Most of the wells completed are apparently capped, pending completion of the pipe line.

Official figures show a production for the entire year 1942 of 37,521 bbl., compared with 14,119 bbl. in 1941.

With the groundwork prepared, by means of explorations, topographical and geological surveys and refinery and pipe-line construction, further increase in production will be a far less expensive matter. What was originally considered the proven field seems to have been materially extended by the limited amount of marginal drilling. With shallow depths, drilling is a rapid matter; it is stated a well can be completed in about 3 weeks. In June 1942 the three original wells, drilled between 10 and 22 years before, were still able to produce an aggregate of 320 bbl. a day, close to their original reported production, indicating that the field is likely to last a long time.

# Barco Operations Are Resumed

EXCEPT for the small crude requirements of the concession, including those of the refinery at Petrolea, producing operations of the Barco Concession in eastern Colombia were at a standstill during the first 7 months of the year owing to lack of tankers to export the oil. Only three cargoes left the sealoading terminal at Covenas during that time. In August, however, the oil began to move to the North American markets and on August 11 gradual resumption of production started in the Petrolea field which is now producing at the average rate of approximately 12,000 bbls. per day, which will be increased in 1944.

Drilling on the Tres Bocas-Socuavo structure, now called the Tibu structure, continued throughout the year. Owing to lack of essential U. S. materials work was confined to operation of one light rig on the northern, or Socuavo, portion of the structure. There was no Cretaceous deep well but three tests of the Tertiary sands in the 4,000 to 5,000-ft. range were completed, each with initial flowing production at the rate of 200 bbl. per day or better of 33 to 37-gravity (A.P.I.) oil on short tests. These wells are Socuavo 3, 4 and 5. Socuavo 3 is on the west flank of the structure, 2½ miles south of Socuavo 2 and 2 miles northwest of Socuavo 1. Socuavo 4 is on the east flank of the structure, about 2¾ miles south-southeast of Socuavo 1. Socuavo 5 is on the east flank of the structure, about 2 miles east of Socuavo 1. Socuavo 6 is a location about 1½ miles northeast of Socuavo 2. Socuavo 7 is rigging up about 2,000 ft. south, 40° east of Socuavo 4. Tres Bocas 4, which will be a Cretaceous test, in the 9,000 to 10,000-ft. range, is starting to rig up on a location on the west flank of the structure, about 2½ miles approximately south-southeast of Tres Bocas 2-A. Tres Bocas 5 is grading location about 1½ miles east of Tres Bocas 2-A. It will be a Tertiary test.

# Decline Arrested in Polish Production

CRUDE-OIL production in Poland, now under Nazi domination, is estimated at approximately 2,500,000 bbl. annually, according to information seeping through German barricades.

| District— | Monthly production (bbl.) |
|---|---|
| Jaslo | 63,000 |
| Drohobycz | 17,500 |
| Boryslaw | 107,800 |
| Stanislawow | 21,700 |
| Total | 210,000 |

In July 1942, limited supplies of most urgently needed equipment began to arrive at the fields. Thus, the decrease in production, which had continued since the war started, was arrested. Drilling of a number of shallow wells was completed in the western and in the eastern part of the oil area.

Construction of the natural-gas pipe line from Daszawa to Stalowa Wola started in 1943. Pipe was acquired from the Reich and four spreads were established along the route, imitating construction practices developed in the United States.

A

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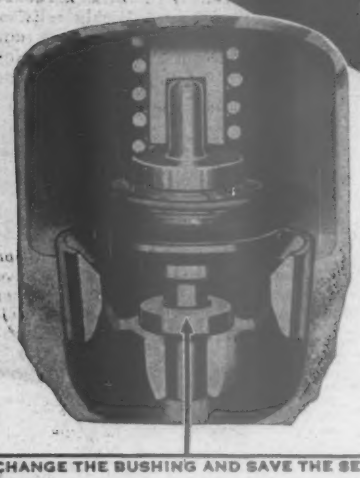
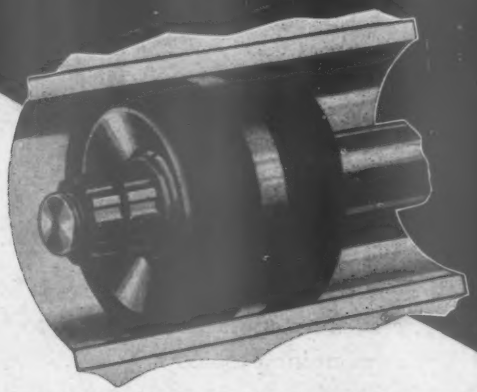


"CHANGE THE BUSHING AND SAVE THE SEAT"



"CHANGE THE RUBBERS AND SAVE THE PISTON"

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Advanced design and extremely tough rubber compound give Mission Piston Rubbers extra long service.

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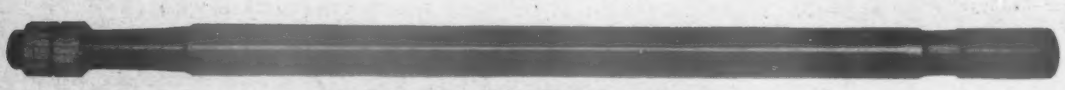
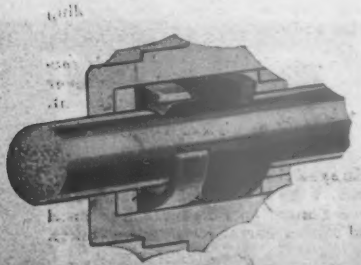


### MISSION PISTON RODS

The double wearing surface on Mission Super-Surfaced Rods gives at least twice the service of File Hard Rods—and Mission File Hard Rods give better service than any competitive hardened rod.

Their wide use is the best evidence that Mission Piston Rods out-perform and out-run other rods.

And furthermore, all Mission Piston Rods are guaranteed against breakage.



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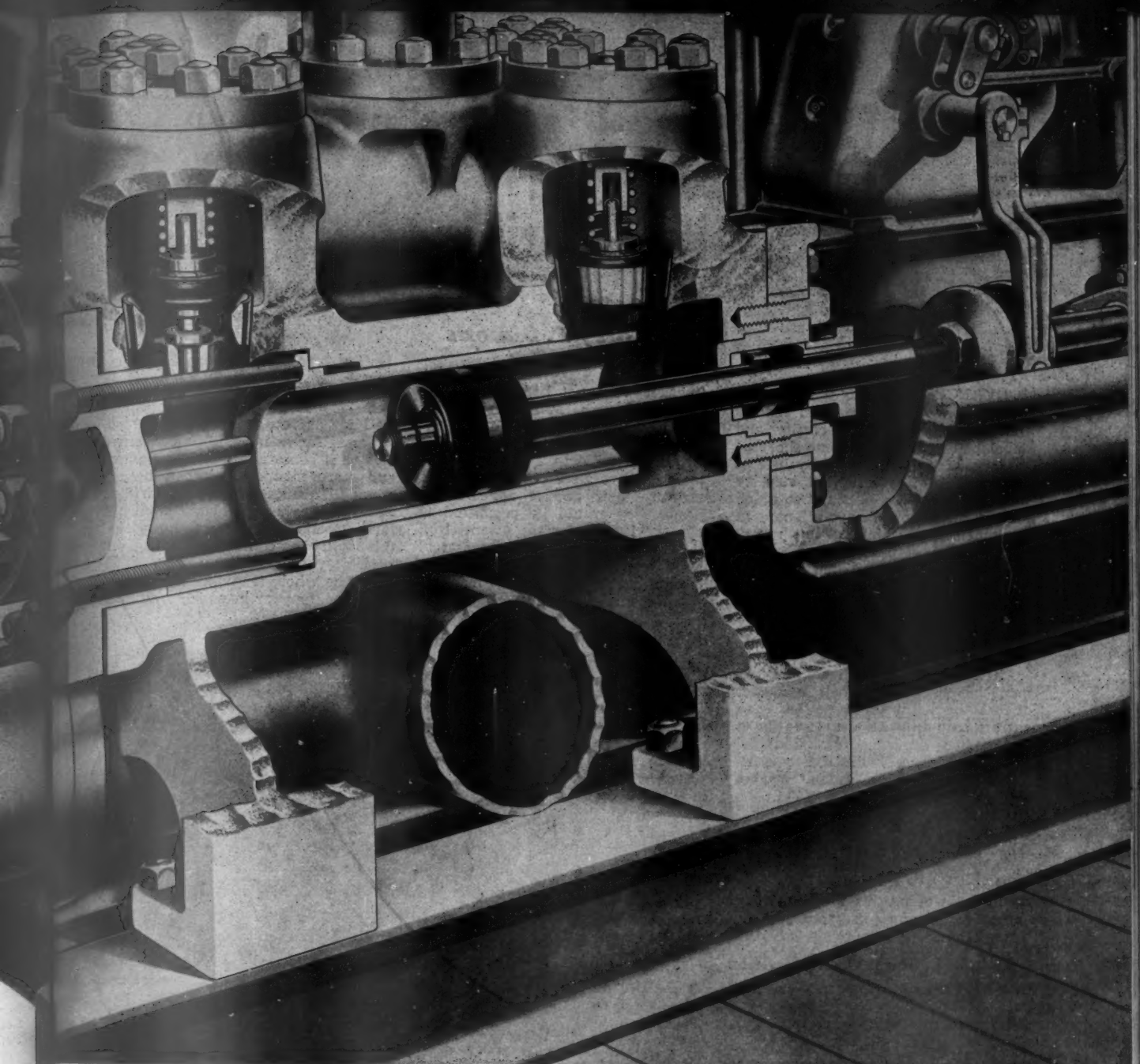

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# War Scarcities Prompt Skillful Use Of Available Drilling Tools

**by Harry F. Simons**

ADVANCES in drilling practice during the year have been mainly those resulting from necessity and developed to overcome some shortage or lack of material and equipment caused by the diversion of steel to war. The trend has been not so much toward the new and revolutionary in equipment and thinking but rather toward the best practices and operation in the conventional pattern. There has been a disappearance of the "get it done and don't spare the horses" school of thought and the development of the "let's do it right" philosophy.

Little new or revolutionary equipment has been offered. As a matter of fact, the drilling industry has been cut off both from its usual supply of material and from technical skill. The chrome-nickel steels favored by drilling men have gone off the market and the manufacturer of oil-field tools and equipment has resorted to heat-treating to obtain a product having the desired strength and resistance to wear from the national emergency (NE) steels. The success of the manufacturers in doing this has been very encouraging and in some cases through the development of the proper heat-treating technique, plus some redesign of a particular item, they have actually improved performance.

The drilling equipment and tool situation were not bad as the year drew to a close. Drilling rigs were generally in fair condition and replacements appear to be available after a wait of 4 to 9 months. Some manufacturers were ending contracts for war items and it appeared as though they would be permitted to make equipment for the essential oil industry. Most critical item was tool joints, which require, in addition to high-quality steel, much machine work for threading and facing.

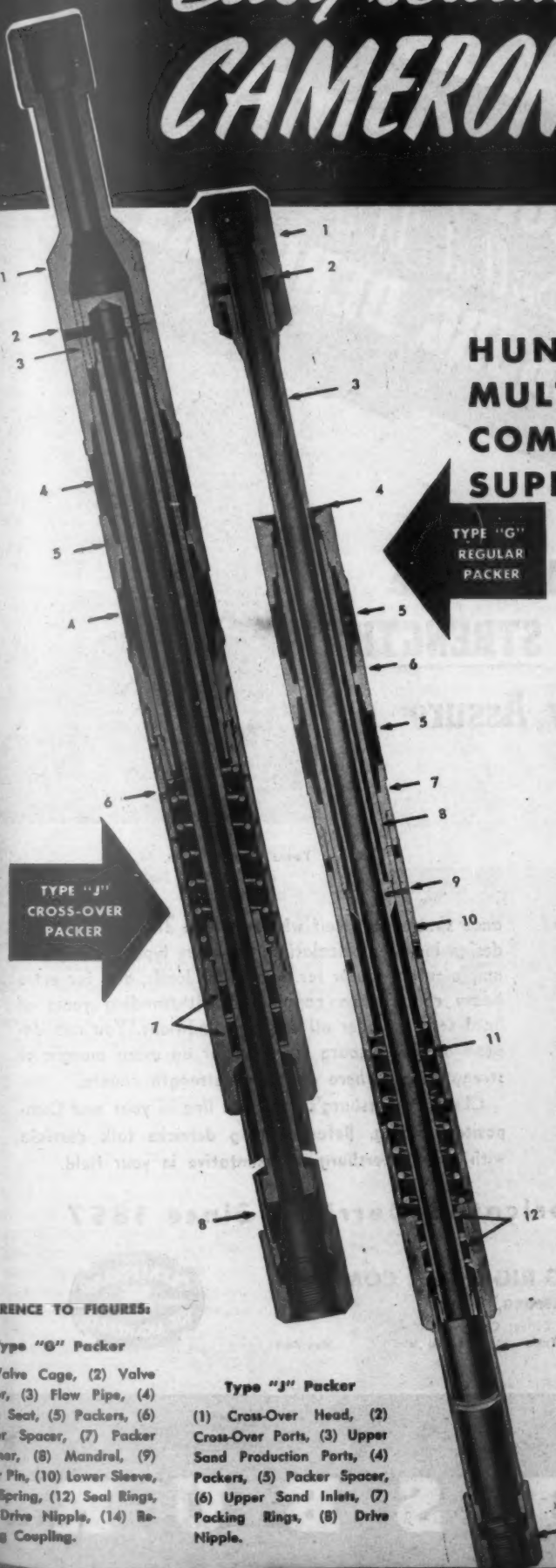
Actually, while the drilling business labored under handicaps during 1943 it has occupied a preferred position as far as material is concerned and with some additional equipment and more manpower it can be expanded. Throughout the year, drilling activity has been constantly on the increase and the forecast shows that this will be continued throughout 1944.

On the whole it might be said that 1943 was the year in which a number

*Placing a clamp-type elevator on a joint of pipe for lifting it into position for welding it into a casing string.*

*Heavy substructure for engines and draw works. Heavy rigs are still preferred for medium - depth wells.*

# *Easy setting-positive sealing*
# CAMERON PACKERS

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**Designed to provide a simplified means of making a pressure-tight packoff between tubing and oil string, the Cameron Type "G" Packer has proved conspicuously successful.**

**The packer is spaced at the desired point in the oil string by the use of spacer-pipe on to the bottom of the hole, which may include either liner and screen, or perforated pipe for production tests. If a liner is set, the packer may be sealed by seating on top of the liner. Seal between tubing and oil string is effected by lowering the tubing string until the valve packer contacts the valve seat. Tubing is further lowered until approximately one-half the weight of the tubing string is on the packer. The seal may be tested by introducing full pump pressure in the tubing or in the oil string. If the pressure lowers gradually this indicates that the valve has not seated due to trash. Release the packer by raising the tubing and run the pumps a few strokes. This will clean trash from valve seat and packer may be reset and tested. The valve packer is designed with a SELF-FEEDING resilient sealing element, assuring a pressure-tight seal even though the seat may have been cut during washing operations. Should it ever become necessary to kill the well, circulation may be established immediately by picking up the tubing string to lift the valve from its seat.**

**Due to the absence of complicated slip and "J"-Tool mechanisms, etc., Cameron Type "G" Packers may be readily pulled from the hole on the tubing string at any time.**

**The Cameron Type "J" Cross-Over Packer is designed for use with Cameron Type "G" Packers when it is desired to produce a lower sand through the oil string and an upper sand through the tubing, this being the reverse of normal dual completion procedure.**

**The Type "J" Cross-Over Packer is made up in the tubing string at the desired point above the Type "G" Packer and both packers are set simultaneously by letting off weight on the tubing string as described above. Flow from the lower zone travels up through the two packers until it reaches the cross-over head in the Type "J" Packer where it is diverted to the oil string. Production from the upper zone enters the Type "J" Packer through holes drilled in the lower sleeve and thus enters the tubing.**

**REFERENCE TO FIGURES:**

**Type "G" Packer**

(1) Valve Cage, (2) Valve Packer, (3) Flow Pipe, (4) Valve Seat, (5) Packers, (6) Packer Spacer, (7) Packer Retainer, (8) Mandrel, (9) Shear Pin, (10) Lower Sleeve, (11) Spring, (12) Seal Rings, (13) Drive Nipple, (14) Reducing Coupling.

**Type "J" Packer**

(1) Cross-Over Head, (2) Cross-Over Ports, (3) Upper Sand Production Ports, (4) Packers, (5) Packer Spacer, (6) Upper Sand Inlets, (7) Packing Rings, (8) Drive Nipple.

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*This spreader box and shale shaker are mounted on a pipe frame which includes a brace for the flow line, giving automatic alignment, if a pipe is used*

of techniques previously known but only intermittently used became widely applied and were accepted as good practice. This includes reverse circulation, drill-stem testing, drilling in with tubing, dual completions and a number of others.

### Reverse Circulation

The year may become known as the era when reverse circulation began to assume its proper place in the petroleum industry. It is still mainly a completion and recompletion method, but its use for this work has expanded phenomenally.

There has been some discussion of using it for drilling the main portion of the hole but the disadvantages continue to outweigh the advantages. There is always the problem of keeping the bit clean. This is accomplished in normal drilling by the jets in the bit, a high fluid velocity being thus obtained.

Reverse circulation has been used to drill over 600 ft. in one case but this was through a very hard rock formation and cleaning the bit was no problem. Salt water was used for a circulating fluid in this case. Where the formation is not gummy or sticky there appears to be no limit to the amount of hole which can be successfully drilled with reverse circulation.

Reverse circulation has a triple advantage of speed, safety and quality of completion. A well can be completed or reconditioned (including a nitroglycerin shot and cleaning out afterward) in 4 to 5 days. Where only ordinary precautions have been observed there have been no cases of stuck drill stem or other delays. The quality of a completion or reconditioning job is indicated by the initial production and the length of time before the well must be worked on again. This is mainly dependent on the thoroughness with which the debris was removed from the well bore in the first place. Normally, reverse-circulation completions give slightly higher initial productions, recompletions generally show very encouraging production increases, and the wells do not require additional cleaning out for a much longer time than do wells completed or reconditioned by other methods.

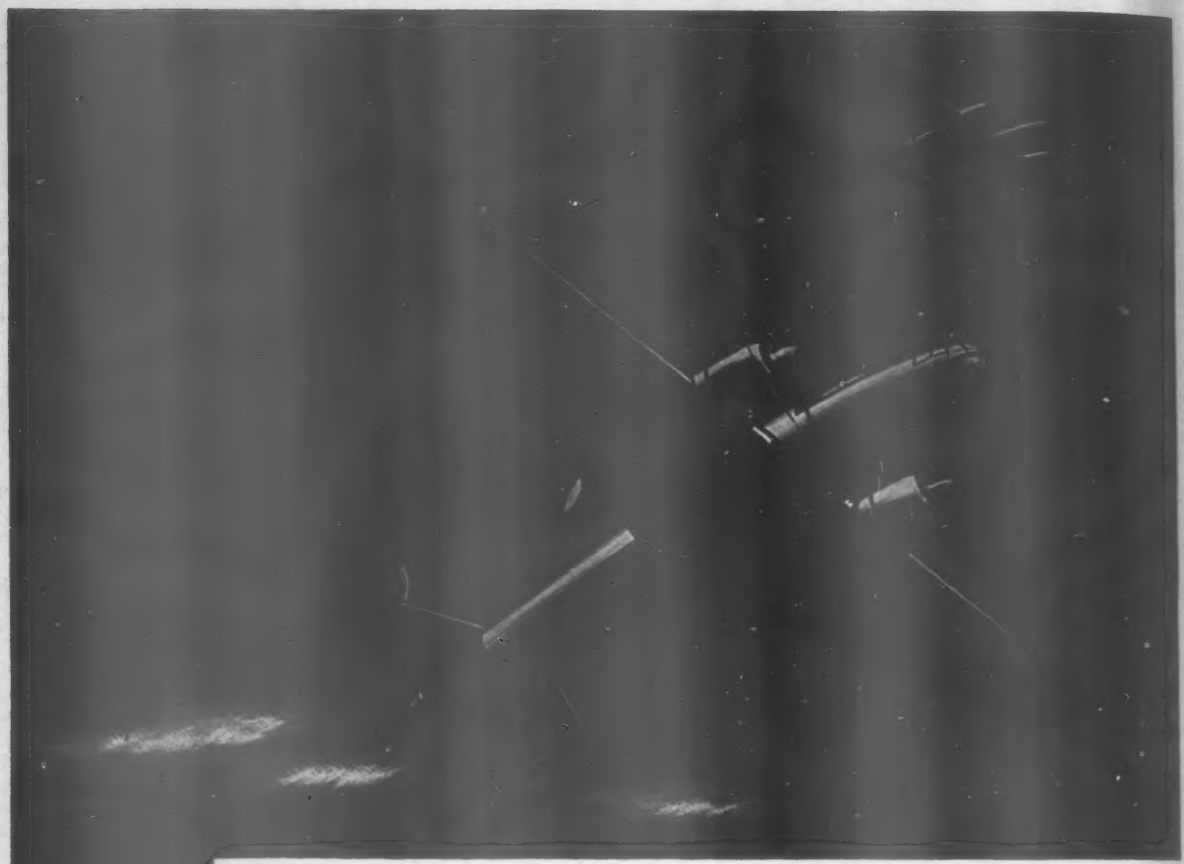
### Tubing Used for Drilling

In most cases, the tubing string used for producing fluid from the well is used for the drilling string in reverse circulation work. Generally, crude oil is used for a drilling fluid, although in some cases where pressures are high, water or a low-water-loss mud may be employed. Several different arrangements for packing off between the drill stem and casing are employed. The drilling fluid is forced down the annulus and up through the tubing, the high-velocity fluid stream thus obtained on the return being capable of carrying a heavy burden. For washing the wall of the hole normal circulation, a jet action, is obtained by perforations in the tubing above the bit.

Early attempts to recondition wells with reverse circulation using crude oil were discouraging because the formation would take such high volumes of fluid. However, it later became apparent that fluid lost in the formation could be recovered by swabbing and in addition the entry into the pay zone and rather rapid withdrawal of this fluid aided in opening up drainage channels. There have been wells in which as much as 3,500 bbl. of oil

*(Continued on page 162)*

*Individually driven rotaries as shown here are being used to increase depth capacity of mechanical rigs as two engines back of the draw works can be used to supply sufficient power for the pump while engine connected to rotary turns drill pipe*



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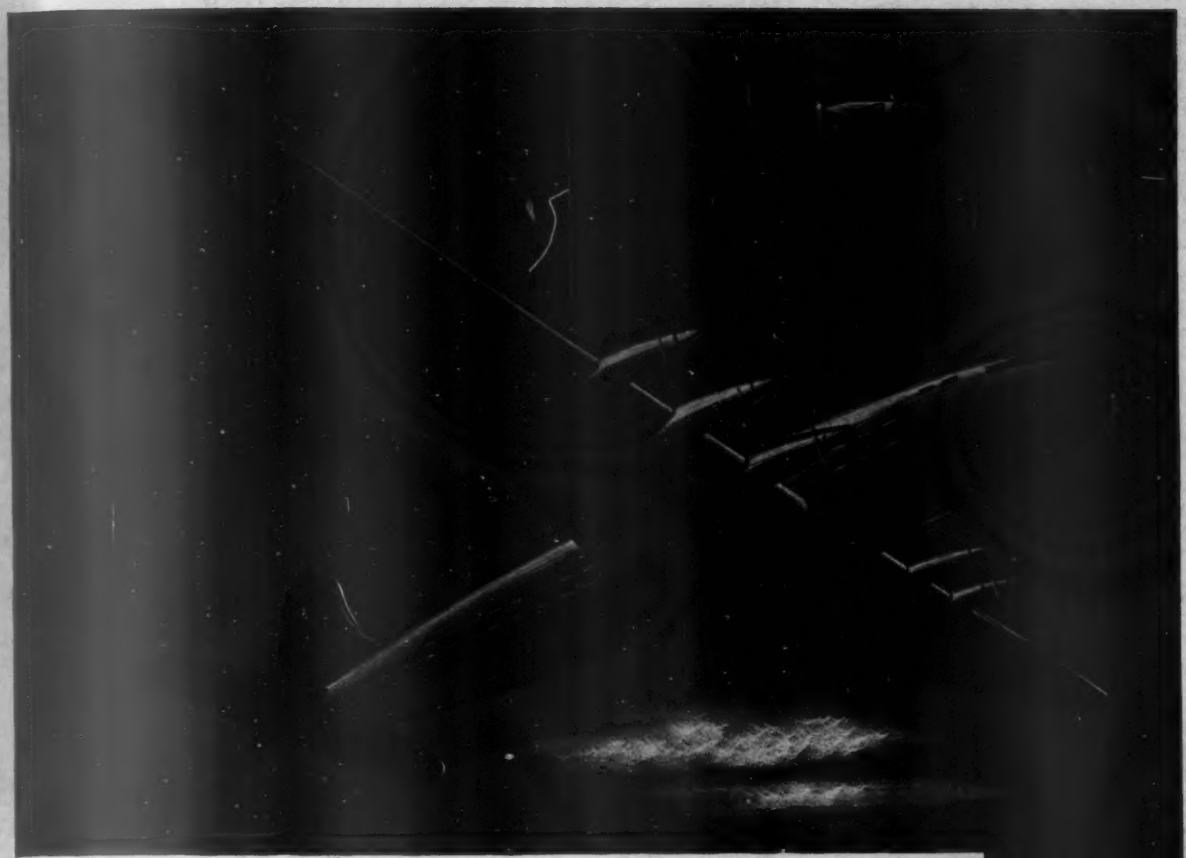

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or new-plant undertakings. Badger is equipped to handle *everything*—under sole responsibility or in co-operation with your own organization . . . from process, design and construction engineering, to material procurement, to labor employment and supervision, down to test-run operation. Badger is open for discussions now.

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went into the formation but was recovered. When such wells were put back on production, and after work oil had been recovered, a gratifying and sustained production increase was obtained.

One special application of reverse circulation has been tried by at least two major companies and deserves special mention because of the results obtained. It is the coring of producing formations while drilling in with reverse circulation.

This operation is accomplished by using the regular hard-formation core head without a core catcher, tubing for the drill stem and a slightly remodeled gooseneck on the swivel. The formation is cored with conventional speed and weight on the drill stem but after each foot or two is made the drilling ahead is halted and the drill stem shaken to break the core loose. The core then rises to the surface along with the drilling fluid, passes through the gooseneck (which has a greater sweep than normal) and into a screened compartment in the circulating tank.

Cores from a 4,000-ft. well reach the surface for examination in about 10 minutes after being broken loose. The break in the drilling provides the data necessary for correlation. No trips are necessary to recover cores and one core head can be used until it is worn out.

Another feature is that cores can be obtained by this method where they would be lost by conventional practice owing to washing action. The effect on core analysis is that the saturation factor is obscured to some extent by flushing with the circulating oil but the water content is more accurately determined.

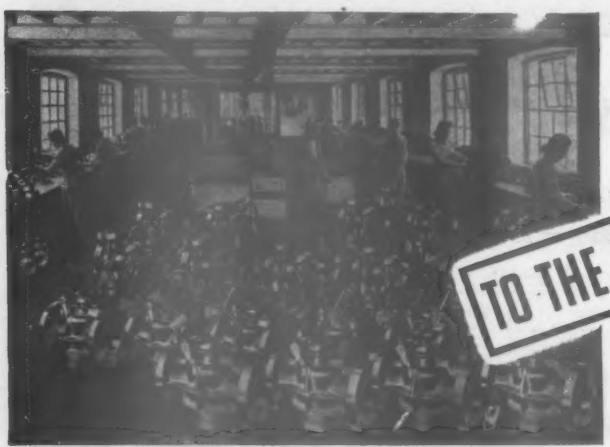
In applying the method, the core head is attached to the bit, the drill stem run in the hole and drilling commenced when the cement plug is encountered. The plug, cement and shoe are cored and then the formation. Unless an unusually long section of formation is to be drilled (over 60 to 80 ft.) one core head and one trip is all that is required. In order that fluid may enter the tubing string while the main entry is blocked by the core, small fluid-bypass holes are drilled through the bit.

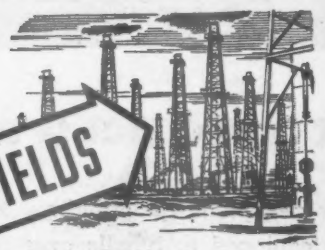
### Drill-Stem Testing

Formation testing through the drill stem before running casing is another tool which has been used for a number of years but which has suddenly sprung into widespread use principally because of the necessity of saving steel casing and the time and cost of perforating and testing a worthless formation. In one area, the total number of drill-stem tests run during the past year was equal to the total number of completions. This does not mean that every well was drill-stem tested. Some wells ran up to eight drill-stem tests.

Drill-stem testing consists of running in with the drill pipe empty and with the tool on the bottom of the pipe. On reaching the zone to be tested, the packer is expanded and the drill stem opened at bottom. Thus the fluid in the well at that point is allowed to enter the drill stem. In many cases the formations tested will flow oil and gas; in others the pipe will fill up with a mixture of gas, oil and oil and gas-cut mud; and in still others mud and salt water will be recovered, depending on the formation content, pressure, etc. Interpretation of the results by a skilled operator is important.

An important factor in the increased popularity of formation tests has been the realization that danger of sticking of the drill string while testing was actually nil. With a mud of reasonable quality there is no danger, and the only case of stuck pipe in hundreds of tests was one in which a mechanical failure in the drilling equipment prevented movement of the drill string for a number of days.



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*This cutaway view shows a high-pressure, gear-operated Newman-Milliken Valve. The cylindrical plug and full round port can be clearly seen.*

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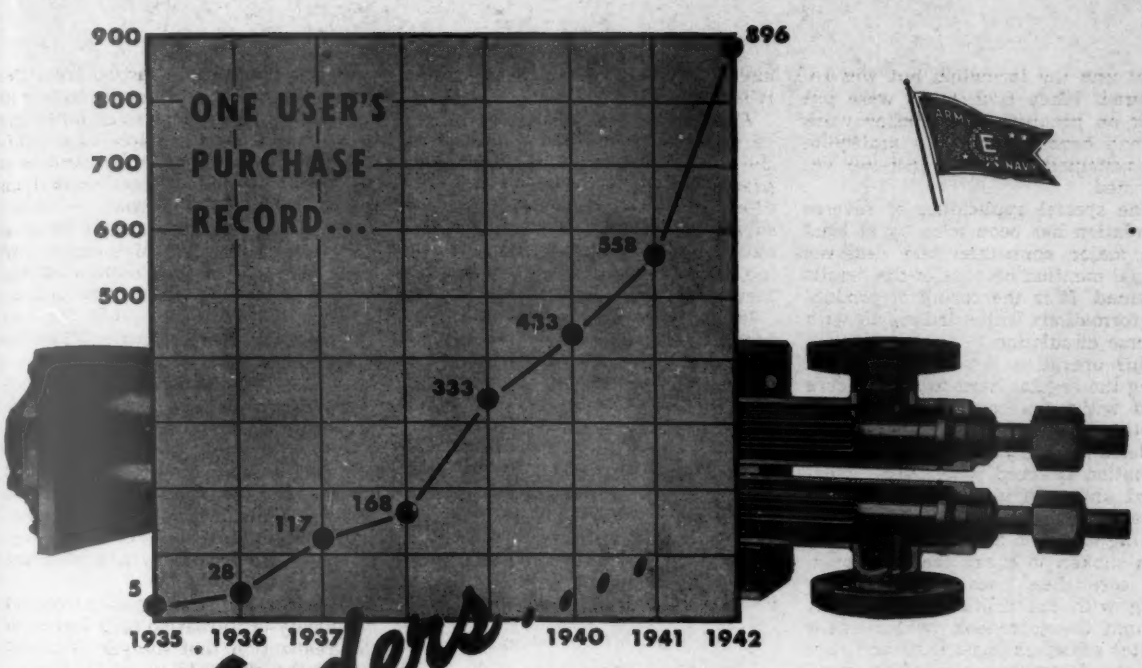


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Assurance that danger of sticking the drill stem was extremely slight has led to the use of longer drill-stem tests. A 24-hour test is not common but neither is it unusual. Some have tested for longer periods.

### Hole Calipers

Hole calipers, because the information to be obtained with them plus their improvement to log larger cavities, have gained wider acceptance. This instrument consists of fingers which follow the wall of the hole and thus indicate its diameter on a recorder at the surface as it traverses the well bore. Data to determine cement fillup, formation breaks and much other information about subsurface conditions may be obtained from caliper records.

*Above: Portable rig designed for either straight drilling or reverse circulation can be used to drill, set casing and drill in. In photo a string of 4½-in. casing has been run and is being cemented. Cementing head can be seen above peak of toolhouse roof*

*Right: Checking and rebuilding of worn tool joints are more commonly employed under war emergencies to maximize service. Here a string, composed chiefly of double-box pipe connected with double-pin subs, is laid down for inspection*

Drilling with tubing is desirable for at least two reasons: (1) reduction of tool-joint expense when outside-diameter wear is a large factor; and (2) elimination of the expense of hauling drill pipe to a well on which a remedial job is to be performed. Both have been attempted and the former has been discussed at length previously. The latter use has been increasing steadily until it is now common practice to drill in a well by either normal or reverse circulation methods using the production string of tubing for a drill stem. The intervals drilled with tubing have been steadily increasing.

During the year, some idea was obtained as to the amount of hole which can be safely drilled with small-diameter tubing of 2 or 2½ in. One well was drilled through hard dolomite for more than 600 ft. with 2-in. tubing. Some of the formation cut at rates as low as 1 ft. per hour. In addition, because a ledge was struck while running in the hole and then twisting the tubing apart, a sidetracking job was necessary. The tubing was not spared abuse during the operation and the greater portion of the string was in suitable condition for use as a production string at the conclusion of the work. Comparatively few joints had to be discarded but a number required repair to threads and replacement of collars.

The conclusions drawn from this experience were that small-diameter tubing could withstand much more abuse than previously thought, that it could be used to drill fairly long intervals of hole but that all-in-all it was a poor substitute for drill pipe.

### Acids for Circulating Fluid

Deepening of wells with acid was attempted in one case where it was found that an untapped pay section was present below a hard lime break in the formation. First attempts to deepen were by a downward-directed acid jet and this was successful to a degree, but formations of low-acid solubility impeded some similar attempts. Consequently, a bit was placed on the tubing and acid used for a circulating fluid. This softened the formation so it could be easily cut by the bit. The bit disposed of the formations which were not entirely soluble in the acid.

### Weighted Acid for Freeing Pipe

In freeing stuck drill pipe with acid one of the difficulties is the placement and the retention of the acid around the obstruction, generally around the bit and drill collars. In many instances the acid is lighter than the drilling fluid and it will tend to work upward. To overcome this the specific gravity of the acid may be increased through the addition of calcium chloride. There is a limit to the specific gravity which can be obtained but weight of ordinary drilling mud can generally be exceeded or equaled.

### Inspection of Tubular Material

Visual inspection of the interior and exterior of drill pipe, subs and drill collars has been supplemented by the magnetic method which reveals obscured cracks and defects. This is particularly applicable to drill collars as a routine procedure or preparatory to building up and cutting off of the end.

The magnetic examination, called Magnoflux, consists of placing the drill collar or other equipment to be inspected, in a magnetic field, sprinkling a light coating of magnetic powder over the steel, discontinuing the magnetic field and then lightly blow-

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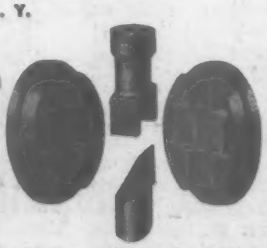

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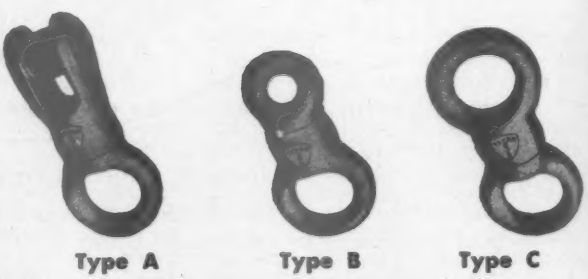

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ing on the surface to remove the excess of the powder. Where there is a hidden crack the residual magnetism in the steel will create a magnetic field and will hold the powder. A hidden defect thus shows up as a line on the surface.

Before a drill collar has its outside diameter built up, it can be examined to see that there are no fatal defects. If there are hidden fractures, the new metal can be applied far enough back from the end to allow cutting off of the dangerous portion preparatory to threading and facing the tool-joint box on the drill collar.

### Drill-Collar Management

Previously it has been the custom to turn down the outside diameter of drill collars after they had worn a specified amount, generally approximately ½ in. under the original size. Thus an 8¼-in. drill collar would be successively reduced to 5 in. At the same time a small portion would be cut off of each end to permit the cutting of new threads and refacing.

With the present scarcity of prewar steel, owners of drilling equipment rebuild the ends of the drill collar to the original diameter before cutting off for rethreading. The rebuilt portion contains some hard-facing material which makes that portion of the collar more resistant to wear. By keeping the portions near the ends of the drill collar built up, the wear of the middle portion is stopped as its contact with the wall of the hole is not so frequent. Each time the drill collar is built up it suffers a reduction in length and eventually becomes so short that it must be used as stock for subs.

### Care of Drill Pipe

Drill pipe now receives the care recommended in previous years. Adequate precautions are now being taken to prevent mud accumulating on the joint threads, boxes and pins are inspected regularly, the pipe is spun up carefully and tonged in the approved manner and generally the speed of rotation has been reduced. Most drilling rigs now include a pipe straightener and crooked joints are laid down immediately and straightened before being returned to the string. Where possible, heavier drill-collar sections are used.

The reduction in the outside diameter wear of the tool joints is still the principal problem. In many areas the formations are both hard and abrasive, or there is considerable hole to be made below hard and abrasive formations. Contact between the formation and the tool joint is frequent unless the pipe is rotated slowly and very little weight applied on the bit.

Oversize tool joints have been widely used to overcome the frequency of replacement and wear subs have become common. Modern wear subs not only include double-pin types for connecting double-box pipe and double box-type for connecting double-pin pipe, but pin and box subs for connecting pipe equipped with the ordinary tool joints. Generally the subs are slightly larger in diameter than the joints so that they will absorb the wear. The pin-type subs can be rebuilt. The box-type subs must be replaced when they are worn beyond service.

Despite the use of subs, tool joints continue to wear in a barrel shape with the greatest reduction in outside diameter taking place at the tool-joint-pipe connection. This is because the tool-joint connection is the stiffest portion of the drill string and the bending of the less-rigid body of the pipe causes this portion of the tool joint to contact the hole most frequently. When the shoulder becomes worn, it must be rebuilt or the joint must be replaced.

One method which has had considerable success is to hardface a portion of the joint adjacent to the shoulder. The entire joint cannot be hardfaced as space must be left for the tongs to grip. Hardfacing metal with a hardness of 9.4 (Moh's scale) applied in a band around the tool joint near the shoulder has proven successful in reducing wear. Experiments have shown that a few tenths of a point difference in the hardness scale will make a wide variance in wear resistance. The same technique has been applied to drill collars, one or more bands of the hardfacing material being placed near the ends to absorb the wear. Considerable experience is required to apply the hardfacing materials successfully.

### Weight on Drilling Bit

Increasing the weight on the bit normally produces a greater rate of penetration, the relation being almost a straight line up to the fracturing point of the formation. Also, it has been demonstrated that speed has a straight-line relation on the rate of penetration.

However, where hard formations are encountered it has been found that a slow rate of rotation, with or without more weight, increases penetration. This is because of a time factor in the articulation of the bit. Increasing the time each tooth is in contact with bottom permits the weight of the drill string to act on the formation and break it down. Fast rotation, or spinning of the bit, does not allow the teeth to gouge into the formation. Unless there is some reason for fast rates of rotation, such as necessity for keeping the hole straight in a sloping formation, lower rates of rotation have been found to produce better results in the harder rocks. There is also less wear on tool joints and drill collars and less trouble with thread failures.

The use of starch in drilling fluid to retard water loss has been expanded because of the results obtained and the discovery of the means of preserving this material. Originally, starch was used with salt-water muds, the salt acting as a preservative. More recent work has shown its applicability for obtaining a low water-loss mud with fresh water as the base. In fact, lower water losses can be obtained with starch in fresh than in salt water.

A water loss of 1 to 2 cc. in 30 minutes in a filter press (100 lb. per sq. in) can be obtained with fresh water using 20 to 30 lb. of the hydrolized starch per barrel of drilling fluid. Fermentation is prevented by addition of caustic with a pH of 12 to 12.5. In addition to a low water loss, a filter cake which is paper thin is developed. Such muds are used for the drilling of formations which will cave if wet to any great extent with water, and for drilling in low-pressure pay zones where muds of inferior quality possibly would seal off oil production.

### Oil-Base Muds

Oil-base muds have been used for completing and recompleting wells where it was undesirable to risk any wetting of the formation with water. Such muds are still in the experimental stage although they are being applied more widely. There are two types being used, one composed of carbon black, blown asphalt, quick lime and crude oil and the other of carbon black, distillate, bentonite and some weighting material.

Primarily oil-base muds are used when it would be desirable but impractical to employ crude oil as a circulating fluid. The oil-base muds can be weighted the same as a regular drilling fluid. Users have been generally gratified over the quality of the completions so the material is desirable from the angle of the results obtained. In one experimental case practically all of the drilling was accomplished using oil-base mud. Such a drilling fluid is relatively expensive, requires considerable skill in application and maintenance and is not as pleasant to handle as an ordinary mud. Where shale is exposed to such muds for a considerable period it becomes gummy and sticky.

### Diamond Bits

Use of a diamond bit to drill a section of flint in one area was attempted. As long as chert was being drilled satisfactory performance was obtained but the intervening layers of softer material caused trouble. Soft formations clogged the cutting surface of the bit. For drilling harder formations, a bit properly hardfaced with extreme abrasion-resistant metal appears still to be the best solution.

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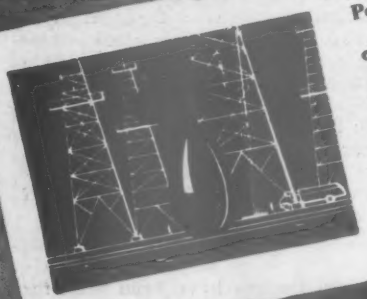

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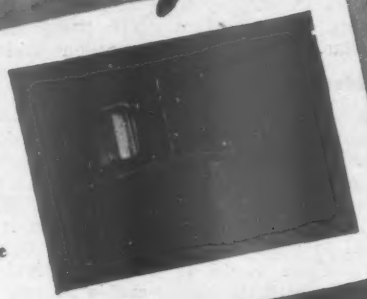

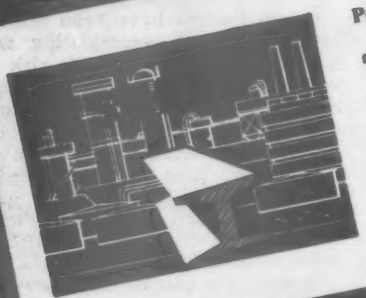

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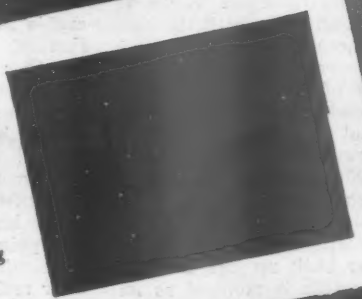

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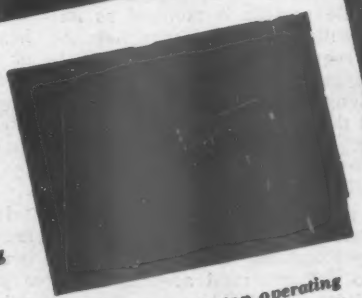

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# Increased Ultimate Recovery Guides Development of Production Practices

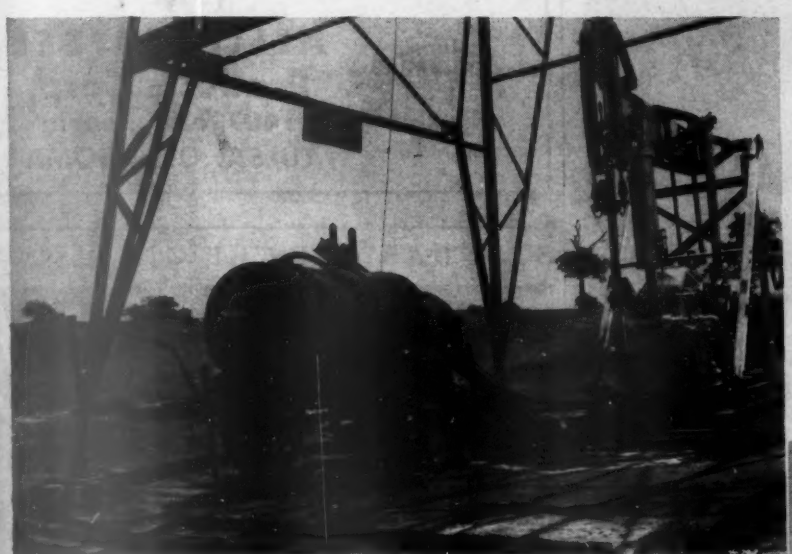
**by Neil Williams**

TRENDS in production methods reflect the intensified efforts of the oil industry to make possible increased ultimate recoveries, effect greater operating economies, and minimize waste. Particular emphasis is being placed upon more efficient utilization and conservation of natural-reservoir energy in primary-recovery operations. More consideration is being given to the value of gas as a source of supply for liquid-petroleum products, particularly the lighter fractions needed for aviation gasoline.

Greater importance is being attached to studies of reservoir conditions and the mechanics and behavior of flow of oil, gas and water in the reservoir. Through increased knowledge of these conditions, it is probable that more effective and efficient drainage can be attained.

Pressure maintenance, repressuring and various types of secondary-recovery operations are being undertaken in a rapidly growing number of fields and on larger scales. Particular new developments are being made in utilization of produced water in maintaining reservoir pressure. Return of formation water to producing zones at down-structure positions as a means of maintaining pressures, as well as disposing of the water, has been initiated this year in a number of fields, notably East Texas.

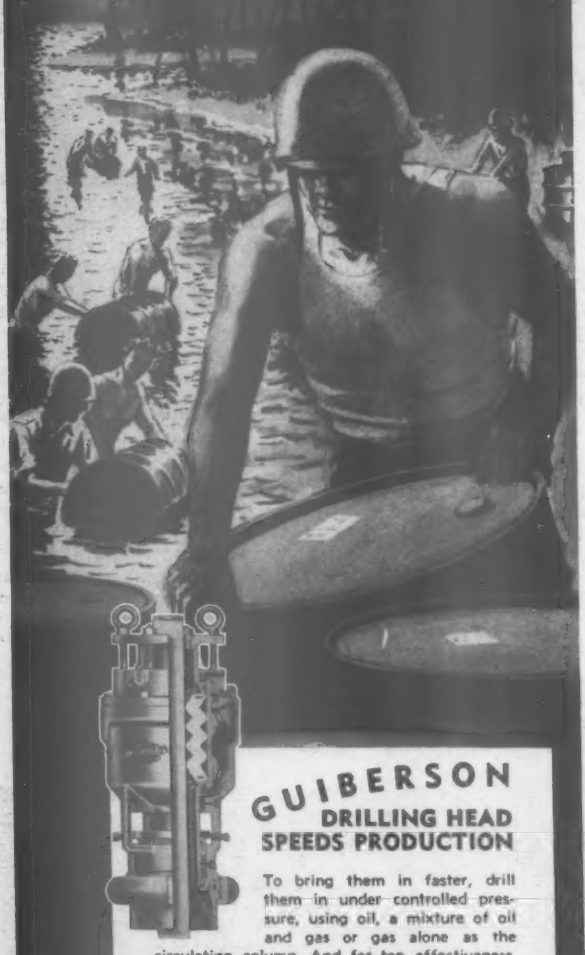
A large measure of success has been experienced with the gravel packing of salt-water disposal wells. The purpose of the gravel packing is to filter or screen out the plugging agents which would stop up the pores in the formation into which the water is being placed. The most common cause of the plugging in the wells



*Left: Portable well-productivity testing equipment for determining effectiveness of pumping methods on stripper wells*

*Below: Running bottom-hole pressure test, a practice regularly followed in modern fields to observe effect of production rates on reservoir conditions*

ALL OVER THE WORLD THE CALL IS FOR OIL



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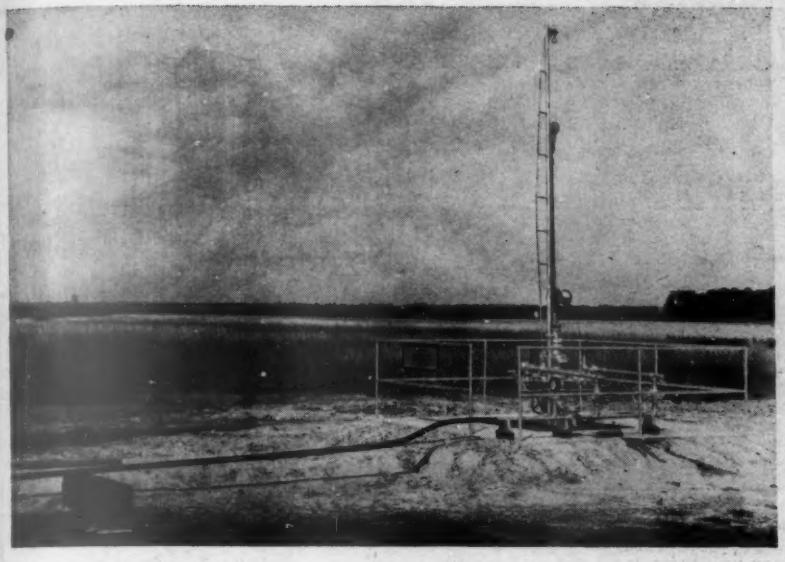


*Many wells bothered with paraffin now are being permanently equipped with small masts, such as shown in the picture, to expedite running of scrapers or cutting tools. The mast also is used for running bottom-hole pressure bombs*

gravel packed is the sludge produced by the sulfide-reducing bacteria.

By loading the hole with gravel the water is forced through it and the sludge from the bacterial action is deposited on it. This can be flushed off whenever the pressure required to force the water into the formation begins to show an upward trend. Generally the flushing of the gravel produces a large quantity of evil-smelling sludge. After flushing the formation will generally take water at or near the original disposal pressure.

In pumping wells, greater consideration is being directed to suitability of facilities to conditions. Intense studies are being made of pumping speeds and their effect on production. Reductions are sought in well repair, equipment maintenance, general lifting costs, and other factors entering into balancing production and profits.

### Production Handling Improved

Practices and facilities employed in handling of crude oil and gas are being improved to minimize evaporation losses and to conserve and utilize the valuable lighter fractions which, in the past, generally were wasted. Vaportight facilities are being provided and methods devised for elimination of leaks, and losses incurred thereby. Progress is being made in crude-oil stabilization by which the lighter hydrocarbons usually lost by evaporation in normal handling are taken off under temperature and pressure control, and then recovered and processed to boost yields of usable products.

Additional incentive is being given for further streamlining of surface equipment, eliminating unnecessary lines, tanks, separators and other such facilities, and for simplifying the handling of production. Centralized field or lease batteries and flow-control systems are being adopted to a greater extent. All this has a close bearing on saving of materials and manpower, as well as adding to the convenience of operators.

Increasing use is being made of "macaroni" (small) tubing strings, usually 1 in. or 1¼ in. in diameter. These are designed to take advantage of the velocity effect of the smaller tubing. In new producers this may be the only tubing string in the well. In old wells already tubed, the small-diameter tubing may be run inside the standard tubing.

In areas where allowables are greatly restricted, it is difficult to keep alive many low-pressure wells or wells with high water ratio when using standard-sized tubing. With regular tubing the effective energy of expanding gas is less than with the macaroni strings.

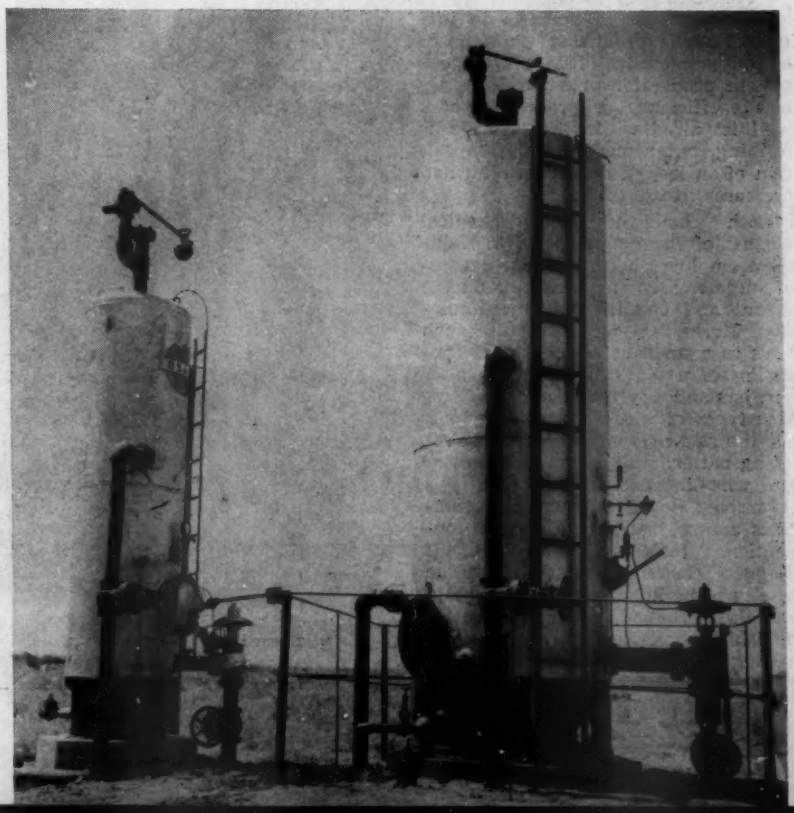
Use of the small-diameter tubing eliminates the necessity for flowing a well "hard" for a short time and the accompanying excessive reduction in bottom-hole pressure. A well can be produced more uniformly over a longer period of time. The flowing life of a well thus is greatly prolonged.

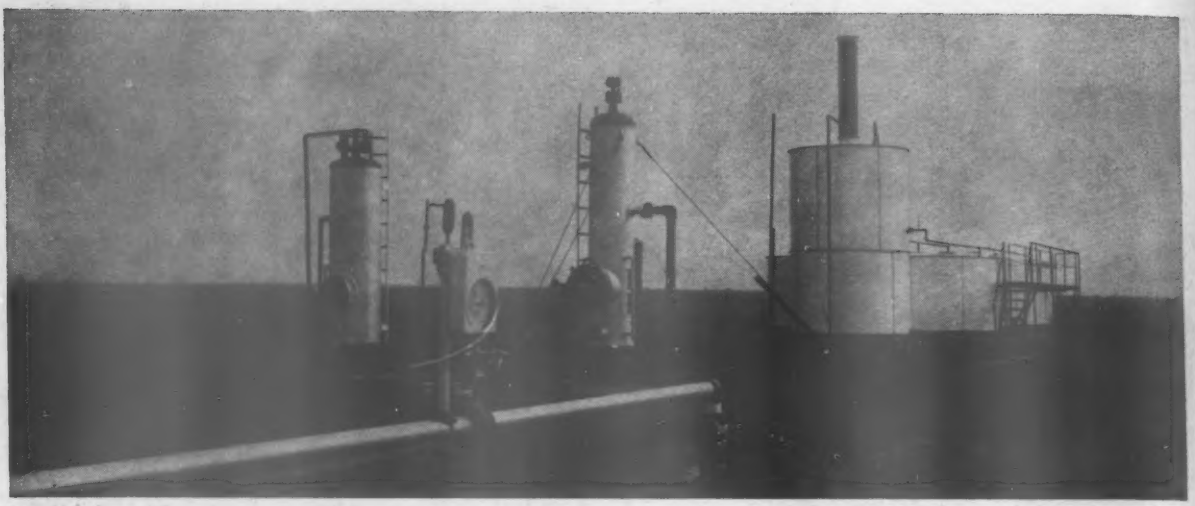
If the regular tubing in the well is perforated just under its hanger to allow gas to enter the annular space between the tubing strings from the casing, several automatic valves placed relatively high in the small string will permit oil to be lifted by gas, using the well's own casing gas.

### Reclaiming Balls and Seats of Pumps

Refacing and grinding of worn pump valve seats and valves for additional service is being found successful in many cases. The work is

*High and low pressure separator installation for stage-separation of fluid production of high-pressure wells. This modern practice permits retention in the production of many lighter hydrocarbons*





*Orifice meter installation on gas-vent line, making possible a check on all gas production and to facilitate accurate determination of gas-oil ratios of producing wells*

being done by several manufacturing companies and some operating companies have provided machines for this work. Important savings can be made in alloys used in the manufacture of balls and seats which are now difficult to obtain.

Many balls can be reground to a degree where they are only 0.015 in. undersize and be nearly as perfect as when new. Seats can be refaced in a lathe, and the balls and seats "lapped in" with grinding compound. Seats have been refaced four or five times. Balls offer a slightly more difficult problem.

**New Tool for Removal of Paraffin**

Accumulations of paraffin in tubing of wells producing paraffin or mixed-base crudes often constitute a serious production problem. Not only is the efficiency or production of a well impaired while the paraffin is forming, but removal of the deposition often is a tedious operation and increases lifting costs.

Both chemical and mechanical means of removing paraffin have been employed with varying degrees of success. Efficiency depends on the extent and conditions of accumulation. Mechanical means require such tools as a small cable-tool outfit consisting of a wire-line socket, sinker bar, jars and a cutter or scraper. Common types of wire-line scraping tools are the slip-ring scraper or hook, rotating cutter, ring cutter, spur cutter and wire-line brush.

In some fields, the paraffin conditions are so bad that all these conventional tools are ineffective. If plugged, conventional tools may be lifted up the hole by the well stream and then dropped, which may result in fishing jobs. Recently, a new-type cutting tool which eliminates these objections has been devised and has been employed successfully in the University field, East Baton Rouge Parish, Louisiana. In that field, paraffin conditions are particularly troublesome with accumulations starting in at a depth of approximately 2,500 ft. Conventional types of cutters plugged easily, and usually scraping of a well required from 2 to 3 hours. On weak wells large chunks of paraffin cut from the walls of the tubing would plug chokes.

The body of the new tool consists of a ⅝-in. cold-rolled steel shaft drilled with 3/32-in. holes for wires and tapped at right angles for set screws. Scratchers, inserted through the holes, are short lengths of 0.092-in. mild plow-steel wire, cut 2¼ in. long for 2½-in. tubing. It has two semicircular knives at the top instead of a single full-circle knife. These are made of spring steel, sharpened on top and bottom. Knives are welded or bolted on the shaft. Fastened at different levels on the shaft and on opposite sides, they provide open passage for flow of cut paraffin and well fluid. The combination of scratchers and two semicircular knives proves more effective than a single circular knife, which leaves a thin layer of packed paraffin on the inside of the tubing. The scratchers loosen and

*Housed central-separator installation in a Rocky Mountain field, showing meter installations on fluid discharge of two test separators. Metering of fluid production is becoming more general practice*

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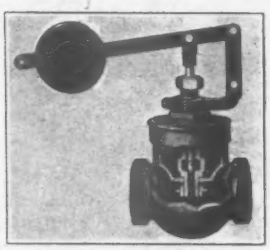

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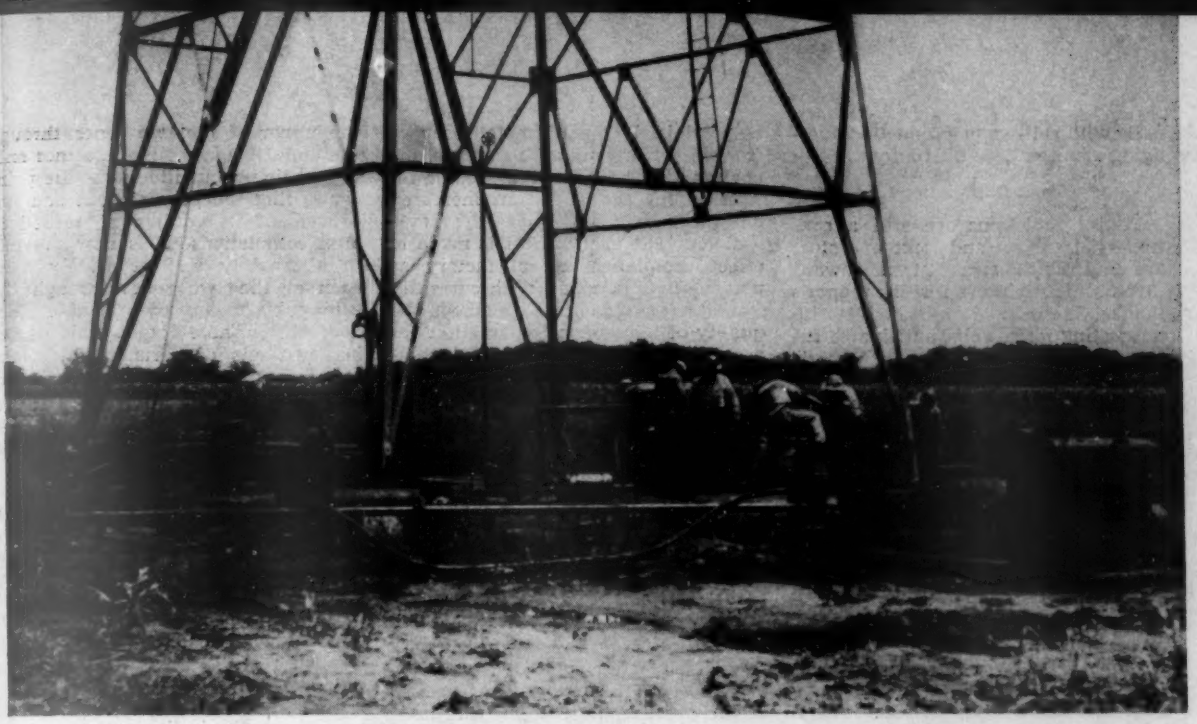


*Cleaning out of producing wells by means of reverse circulation is a newly developed practice. The small pump at right takes suction from a portable oil tank, circulating the oil down the annulus and out the tubing*

break the paraffin into small chunks from the walls of the tubing, and any remaining accumulation is removed by the overlapping knives.

### Controlled Flooding Methods

One of the major problems in secondary-recovery operations is the tendency of injected water to channel through zones of highest permeability, leaving tighter zones unpressured. To overcome this problem, some operators are experimenting with plugging the more permeable zones, using a substance that congeals at formation temperatures. For this service a low-grade petroleum-wax distillate has been tried fairly successfully. This product contains considerable wax and residue. Heated to a temperature of approximately 120° F., it is readily pumped into the injection well and penetrates the more permeable zones a considerable distance before cooling and congealing, sealing and blocking the more open pores. The distance penetrated into the zones varies according to permeability. Less permeable zones take very little, and are thus left unblocked for passage of repressuring water. From 15 to 50 bbl. of distillate is needed per well. An ordinary cementing truck can be used for injection purposes.

Increasing attention is being paid to prevention of evaporation losses in handling and storage of crude. In the past, however, due to lack of means for determining accurately the gravity of crude under field conditions, it has been difficult to learn the extent of these losses and whether they were sufficient to justify expenditures in equipping regular lease tankage with back-pressure vent-line valves, or for replacing or rebuilding tanks to provide more leakproof conditions.

Recently a portable pressure-gravity test unit was introduced that permits accurate determination of gravity under various conditions. With it, by checking production and gravity for one period of time against the production and gravity loss for a subsequent period, the extent of losses for any period can be easily determined. With this knowledge it is possible to check the condition of tankage and back-pressure equipment already installed, since increased gravity loss for a given amount of production is a direct indication of poor valve operation or increased vapor leakage through tank decks, gaskets or plates. Where a wildcat producer has been completed, the pressure-gravity test unit is used to determine the most desirable tank-battery installation.

The device provides for testing the gravities under uniform temperature and pressure conditions.

### Stage Separation

Use of two separators for oil production is being employed on an expanding scale. The object is to retain more of the lighter ends in the crude oil instead of venting them into the atmosphere along with the gas. This raises both the gravity and the volume of the crude oil produced. One objection raised to the practice is that these lighter ends will later escape. However, proponents of stage-separation methods contend that actually the crude oil obtained this way and run to tanks is more stable.

In one type of installation the high-pressure separator operates at 125 lb. per sq. in. with an incoming pressure from 500 to 700 lb. per sq. in. The other separator operates at 40 lb. per sq. in. and a pressure is held on the tanks. A gravity increase of 1° is obtained.

Liquid level in the separators is controlled by a motor valve. In addition to the frangible disk safety head the separators are equipped with weight-loaded pop valves.

### Pressure Maintenance

Reservoir - pressure - maintenance projects, employing as their medium of pressuring the return to the producing zone of formation salt water are increasing in number. The largest and one of the most recent projects of this type is that now under way in the East Texas field. The return of the produced water to the formation not only reduces the net fluid withdrawals, thus minimizing rates of pressure declines, but also provides for the disposal of the salt water which is a particularly important consideration in East Texas. Benefits of salt-water injection from a pressure-maintenance standpoint already have been felt in the East Texas field, where the project was initiated only this year. Pressure drop in this field per barrel of oil produced has been less this year than at any time during the past 5 years. During recent months total gross fluid withdrawals from the East Texas reservoir have increased to more than 800,000 bbl. daily, but with increased volume of water being returned to the formation, net withdrawals have been cut to less than 600,000 bbl. daily. Salt water injected during November averaged approximately 278,700 bbl.

daily with salt-water production averaging about 427,500 bbl. daily.

### Dual Completions

Dual completions are still a controversial subject and some operators are resisting the current trend toward them. Chief reasons for the opposition are the difficulty of satisfactorily completing some wells, anticipated future difficulties, the lack of experience with the equipment which will assure its success and the failure to effect the greatest ultimate recovery from both zones. Up until recently there was also the objection that for years the petroleum engineer had contended the most efficient way to flow a well was through tubing and now many of these same men were advocating flowing one zone through the annular space.

Regardless of the objections, dual completions are being widely adopted as a method of production, the principal impetus being the shortages of steel and drilling-crew labor. There is also the economic angle which includes the increased costs of drilling, completion and operation of a well while the price received for the crude oil at the well remains static. The operator, from a practical standpoint, has to strive to obtain greater daily oil production while keeping initial costs and the current charges as low as possible. If the ultimate recovery from either or both zones suffers, the operator hopes to show a greater return on his capital by an increased daily income.

Meanwhile, every effort is made to effect completion as satisfactory as possible in both zones. With currently available equipment and methods the quality of a duel-zone completion approaches that of a single-zone completion. As for the operating difficulties, that is a bridge to be crossed later although there are known methods for meeting practically any problem which can be anticipated. There is also the strong possibility that pressure-maintenance or repressuring methods may be widely adopted and in a number of fields this will reduce the well-operation problems and difficulties.

As for the performance of the equipment, this is a problem which will solve itself. While some of it may not be entirely satisfactory to an exactist at the present time, before the normal condition returns to the oil fields there will have been enough experience, testing of equipment, improvement of various devices and the development of new ones to the point where required equipment will operate as smoothly as any of the present standard items.

Overcoming objections to flowing the upper of the two zones through the annular space eliminates not only this criticism but illustrates the point concerning the development and improvement of equipment needed in dual completions. It is now possible to alternately and separately flow each of the two zones through the tubing by means of a double side-door bottom-hole choke. This device has two sets of ports in the choke mandrel and two sets of ports in the choke landing nipple and by raising and lowering the mandrel the zone to be produced through the tubing can be selected. As most wells will flow the allowable production for a month in a comparatively few days, the position of the choke needs to be changed only once a month. This is done by running in the choke-setting tools on a single-strand wire line and pulling the choke mandrel up or driving it down.

### Radioactive Logging

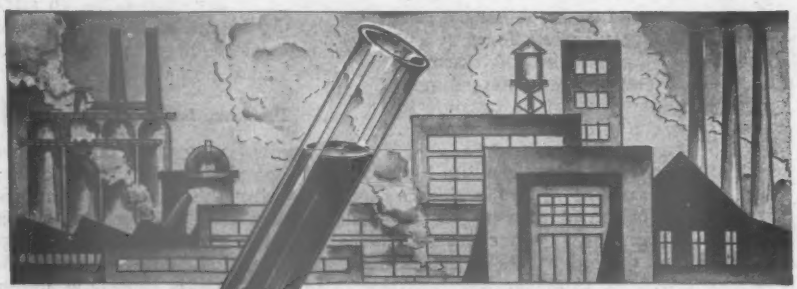
Some operators who have developed properties in the lower pay zone only to have their neighbors come along and exploit both zones through dual completions are not without relief as they can locate the upper horizon with radioactive logging devices and can then perforate and dual complete, according to determinations.

Selective placement of injected gas in a reservoir undergoing pressure maintenance or repressuring is a phase of operation that is receiving increasing consideration. This practice provides for the mechanical control over the particular zone or zones within the reservoir into which gas is returned so that all may receive the benefits of pressuring.

It is known that, generally, permeability of a reservoir is not uniform. Instead, it may vary widely from top to bottom in zones. These zones also may have widely varying horizontal permeability with little or no vertical permeability. This does not mean that there are sharp lines of demarcation between the different zones.

When gas is injected in a reservoir without artificial control over where it goes, it will enter first the zones of greatest permeability in the order of their degree of tightness. This may leave the zones of greater tightness unpressured, resulting in uneven distribution of the gas, and, in turn, an irregular movement of water (in water-drive reservoirs) upstructure.

Mechanical control over the gas placement calls for setting the tubing with a wall packer at a selected point in the producing formation, and providing for injection of gas both through the tubing and the casing-head and annulus. Gas injected through the tubing will be directed only to that part of the formation below the packer, while the gas

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through the casinghead will go to the part of the formation above the packer. By this the volume and pressure of the gas to each portion of the formation can be varied according to needs and according to the ease with which the respective sections take the gas. Greater volumes and pressures can be applied to that part of the formation having the tighter zones. The setting of the packer can be changed from time to time if necessary.

### Corrosive Water Troublesome

Casing failures have been a major source of trouble in old producing wells. This is particularly true in areas having corrosive water in upper horizons. The water, if not adequately shut off, finds its way down behind the pipe and in the course of time corrodes the pipe causing leaks that permit the water to contaminate production of the well. Repair of these leaks sometimes is a difficult and costly procedure, and in turn reduces the net returns from the well. In the case of old wells nearing their economic limit, the expense and trouble may not be justified by the additional production that may be recovered, and a well which otherwise might be kept on production may be abandoned leaving needed oil in the reservoir.

To forestall this problem and make possible prolonged life of wells in these areas, operators are giving increasing consideration to means for shutting off extraneous water from the upper sands and providing for the protection of casing when completing wells. One means of doing this is to cement the oil string to the surface, or at least to a point above the uppermost water sand or exposed formation behind the pipe. There has been a definite trend toward this practice in the shallower producing areas such as Kansas.

This practice in itself involves a number of problems and considerations, and many attempts to cement high behind the pipe have proved unsuccessful. It often is hard enough to get a good job even when attempting to cement only around the lower part of the casing string, so when trying to cement to the top of the pipe there are still greater chances of failure. One of the chief difficulties is the loss of cement in porous formations and fractured sections. Another factor is the time involved in circulating sufficient cement before it begins to set. Also, the hole itself may be irregular in size and require much more cement than calculated. To offset the latter hazard, the use of calipers is becoming more general to determine the exact size of the hole, from top to bottom. The method permits location of caves and determination of their extent.

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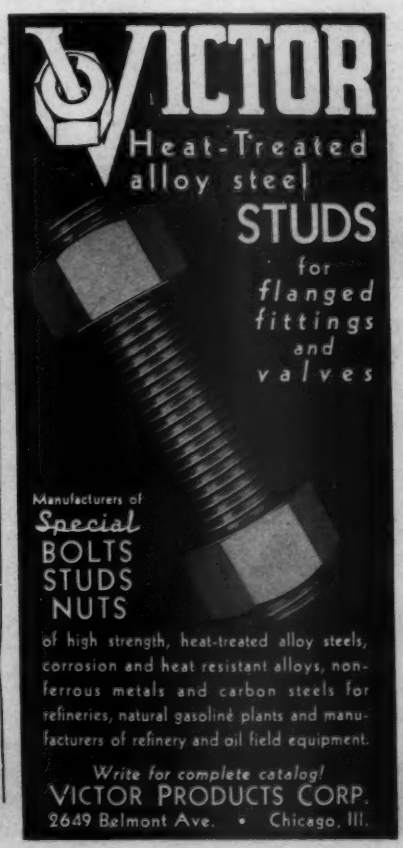

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# Implementation of New Processes Brings Revolutionary Changes in Refining

*by Arch L. Foster*

TWO factors have exerted strong influence on the refining industry this year. These are actual crude shortages, and the development of new processes with their demand for implementation. With the increase in demand for purely military-petroleum products, light fuels which it has been intimated will equal or exceed prewar motor-fuel demand, and hugely augmented requirements for heavier fuels and lubricants the failure to find as much new oil as was being produced the last few years has become acute, demanding drastic methods for solution.

One phase of the problem which has complicated matters is that practically the only avenue for increasing crude output is in the West Texas sour-crude fields. A number of refineries have been processing large amounts of these crudes for many years, yet the production has never been up to the optimum because of the availability of sweet crudes elsewhere to meet maximum needs.

### Sour-Crude Problems

Sour crudes are generally of mixed-base or mildly naphthenic types which give good results as to octane number, volatility, etc., in motor fuels, but which offer decided problems in purification to remove sulfur and sulfur compounds which are in many cases extremely corrosive during high-temperature processing and are poor in lead susceptibility. Therefore, their refining requires special equipment and some special processes, neither of which are normally present in the plant which has been handling sweet crudes. While satisfactory equipment and processes are known and have been in use for years, the equipment, or rather metals, for building this equipment are critical for war purposes in most cases and are difficult to obtain for non-military construction.

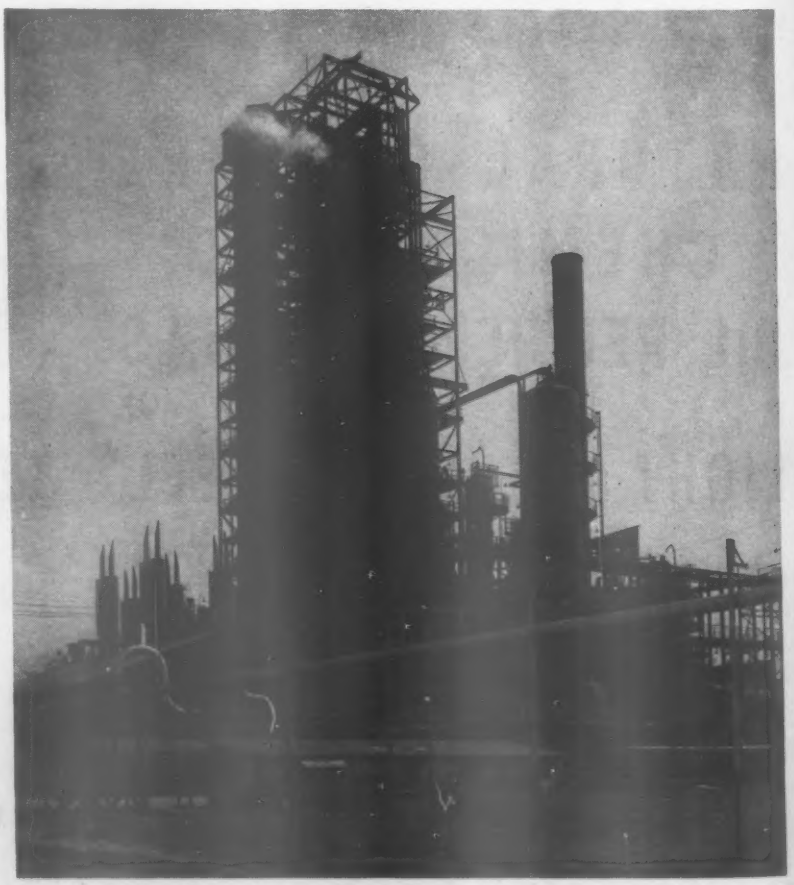
Handling sour crudes economically demands that noncorrosive alloys be employed especially in cracking coils, heat exchangers and similar points where high pressure-temperature conditions induce severe corrosion. The mildest alloy which can be used is the so-called 4-6 chrome-½ moly tubes and fittings, which are satisfactory for the less corrosive sour crudes. More commonly, either steels in the stainless range, that is, 11-13 per cent chrome, are employed, but in many cases the refiner uses 18-8 chrome-nickel steel, which has the advantage of withstanding almost completely the attacks of sulfur crudes but it costs 12 to 16 times as much as plain carbon steel.

Lining of vessels such as fractionators, heat exchangers, flash and reaction chambers with thin alloy sheet is steadily increasing, the lining being installed in strips welded together or in similar manner to completely seal off the carbon-steel inner surface from contact with liquid or va-

**Refining technology is trending toward more highly specialized processes, synthetic products of greatly accentuated properties for a given purpose. The refining industry has become a chemical industry.**

**Immediate trends in equipment are toward less expensive alloys and plain carbon steels in the newer processes where erosive or corrosive catalysts are not employed, taking advantage of the lower pressures and temperatures obtaining in the newer processes.**

**Exploration and research for petroleum substitutes has received impetus from the threatened shortage of petroleum, including especially oil shale, coal hydrogenation.**



*Catalytic cracking is one of the new "conjuring sticks" of the refining technologist, typified by this Fluid unit placed in operation recently*

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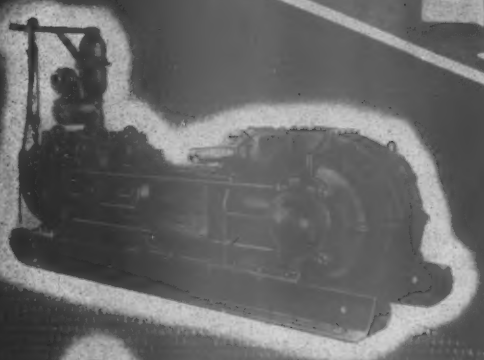

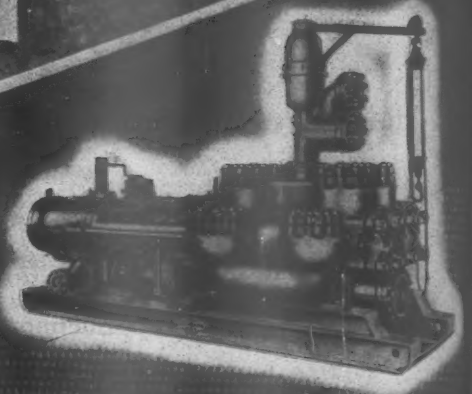

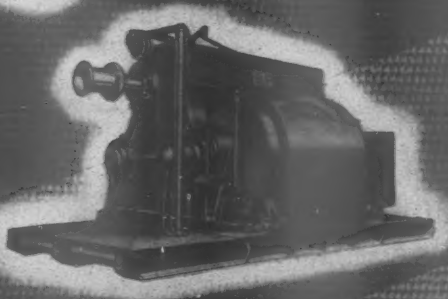

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Tubing
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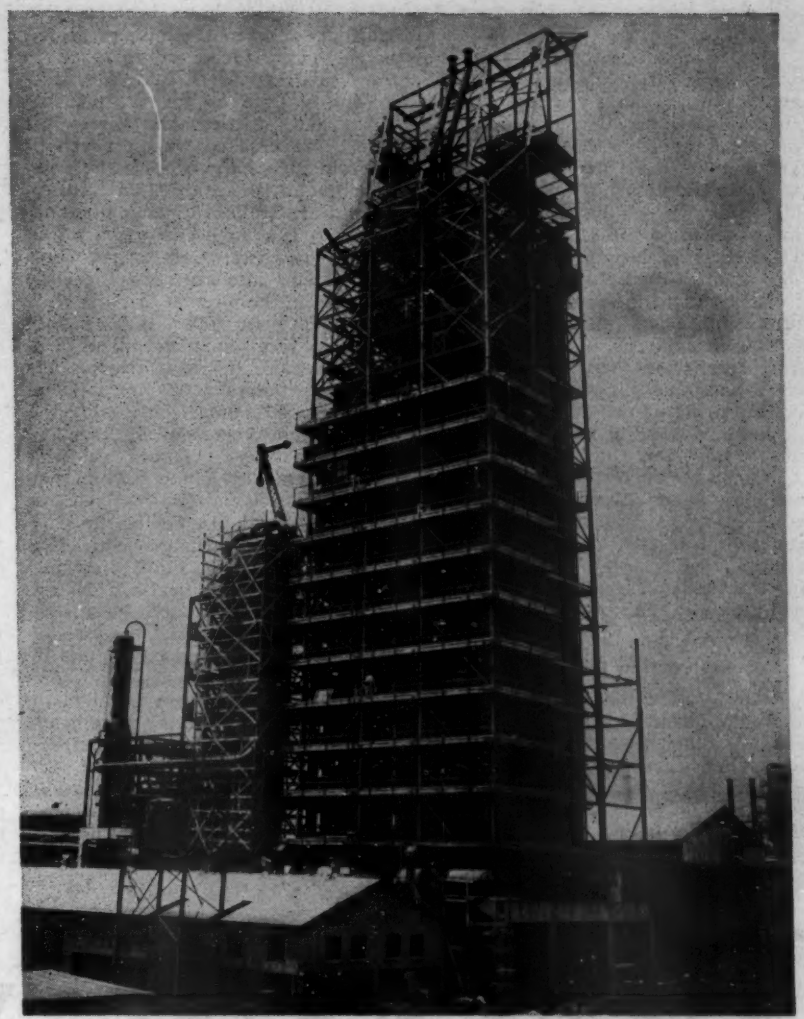
Tongs
Tool Joints
Wire Rope

pors. Most commonly this sheet is stainless steel of 11-13 per cent, although 9 per cent chrome and up to the familiar 18-8 alloy has been used. One drawback to 18-8 alloy is that its expansion coefficient is 40 to 60 per cent greater than carbon steel, and must be "tacked" to the vessel wall at more closely spaced points than with stainless (11-13) steels which show a slightly lower coefficient than carbon steel. To offset the air-hardening tendency of stainless steels, columbium, titanium or aluminum are added in small portions. If carbon is reduced to less than 0.10 per cent these alloying metals are not needed to avoid air hardening. Sheets of $\frac{1}{16}$- to $\frac{1}{8}$ in. are normally used.

Gunite linings are much less costly than metal sheet, but must be renewed each 2 years or so. They are eminently satisfactory for resisting practically all types of corrosion except that caused by acidic constituents which attack silicates or basic coating materials.

Treating sour-crude distillates offers another complication for the refiner of sweet crudes. General treating methods include sulfuric acid which, especially for motor fuels, is most efficient when carried out at low temperatures requiring artificial refrigeration. Catalytic desulfurization is efficient and advantageous especially in improving octane number and lead susceptibility but recovery of sulfuric acid requires special equipment. The various special sweetening processes also are ready-made for treating high-sulfur distillates but require special equipment and some time for installation at a time when equipment is difficult to obtain without high priority.



*The Thermofor catalytic cracking process takes its name from the furnace used to regenerate the spent catalyst, has a strong part in war refining processes, towers 20 stories or more above ground level, as does the Fluid unit shown with this article*

### Metals, Equipment for New Processes

Demands for equipment presented by new processes are directly opposed. Catalytic processes are generally carried out in the refining industry at low pressures and at moderate to high temperatures. These conditions allow the use of either mild alloys or plain carbon steels. Where formerly in thermal cracking at 200-1,000 lb. per sq. in. at 900°-1,050° F., still tubes of 11-13 per cent chrome to 18 per cent chrome and 8 per cent nickel were required to withstand operating conditions, the 0 to 50-lb. per sq. in. gage pressure and 750°-900° F. temperature for catalytic cracking make carbon steel the ideal material both from cost and service viewpoints.

Correspondingly much cheaper metals, ferrous and nonferrous, may be used in heat exchangers, towers and condensers for handling charge to and products from catalytic-cracking units, because of the absence of severe operating conditions which accentuate both corrosion and erosion. Catalytic cracking, alkylation and isomerization processes, however, offer both corrosion and erosion obstacles to the full enjoyment of the advantages just enumerated. The handling of solid catalysts requires the use of metals which resist the erosive, abrasive action of the solid particles, especially in the Fluid Catalyst and Thermofor processes where the catalyst is moved about in a regular cycle with the resultant opportunity to wear away metal containers. Another type of catalyst, such as anhydrous aluminum chloride and anhydrous hydrofluoric acid, introduce the chemical type of corrosion. In either case metals must be used which show minimum damage from these causes.

As a result of the contradictory conditions, wherever mechanical erosion wear or chemical corrosion are low or absent the equipment maker and the refiner is going back gladly to carbon steels or to low alloys such as 2½ per cent chrome, or 4-6 chrome where formerly, in analogous operations, stainless or 18-8 alloys were used. Where catalyst or refining-agent corrosion is present, the requirements for alloys is accentuated. For example, valves for thermal-cracking installations formerly requiring these expensive alloy trims now can use carbon steel even at high temperatures with sweet crudes. Where HF or $AlCl_3$ catalysts are used one of the favored alloys is Hastalloy B; monel is returning to its own in some measure for various purposes. A new experimental idea which has not had time for adequate testing as yet is Lithcote for valve body surfaces, etc., in which a resin (bakelite) is solidified on the surface as protection against corrosion or erosion. Working surfaces on valve gates and seats cannot be so coated. Hastalloy is expensive and hard to machine. Acraloy has been used as have considerable amounts of stellite, the latter espe-

cially where mechanical abrasion is involved.

For pumps and compressors the same generalities obtain for valves and fittings. Some 9 per cent chrome steel has been used in pump and compressor linings and for valve trim. For handling corrosive mixtures such as hydrofluoric acid catalyst-charge oil and with whatever water may have collected, 18-8 chrome-nickel, 11-13 chrome, Hastalloy B are among the widely used materials. Where formerly under the pressure-temperature conditions similar to those obtaining in catalytic alkylation, cracking, etc., plain carbon-steel pump cases and impellers were used, refiners are using alloys of different compositions, depending on the job to be done. However, the trend in these uses with their resultant added costs are more than offset by the greater volume and savings of the trend for general purposes to carbon instead of alloy steel for large equipment used in catalytic-cracking units and in many applications in the other catalytic processes.

### Few New Designs

Relatively few new designs in general equipment have been made. Some special adaptations of existing equipment, especially that with stirring and agitating accessories, have been adopted from the chemical industry in synthetic-rubber manufacturer but these have been applied sparingly to normal refining processes. Some unique ideas are involved in the design of various catalytic-cracking units, such as the facilities required for the separation of catalyst dust from cracked vapors, systems for bringing charge-stock vapors into contact with catalysts in countercurrent or parallel flow, but these designs are under secrecy control in nearly all cases. Catalyst-regeneration systems also are receiving close attention in the attempt to reduce the installation and operating expense and to reduce the material requirements to more economical levels. Interesting developments along this line are reported unofficially on the Cycloversion process of Phillips Petroleum Co., but details are withheld.

One recent development which has been installed widely this year in defense plants — practically the only refining units constructed—is the Iso-Flow type of heater. Built somewhat on the de Florez vertical-coil design, this unit is said to show a large saving in material required, in ease of operation, cleaning and repair, and in daily throughput and heat input per unit of cost. It has been installed in a large number of plants where heating efficiency and low material requirements are highly important.

Some simplification of fractionating tower construction has been accomplished, such as in the Glitsch type bubble tray and accessories. This type of construction replaces the older, heavier, self-supporting type of plate with a plate built in sections. Under each "seam" of the plate a girder support of angle iron or I-beam is installed, and to this beam, also to the angle iron around the inner periphery of the tower shell, the plate is attached by means of clamps. Risers are fitted over flanges around the plate openings, and the entire assembly can be built of much thinner metal, using punch-press and die-stamp methods rather than the more expensive and cumbersome casting and shaping employed on heavier installations. These methods conserve metal, speed up production and installation, reduce tower weights and show other outstanding advantages especially where output speed is imperative, investment costs are important factors, and metal supply is limited.

### Catalytic Refining Spreading

Catalytic refining processes, especially those involved directly in the production of rubber intermediates and of aviation-fuel components, have occupied the center of interest and effort of refining executives and refining technologists during the year. Technologists concentrated on these processes as vital developments in providing suitable war products, in improving them technically to in-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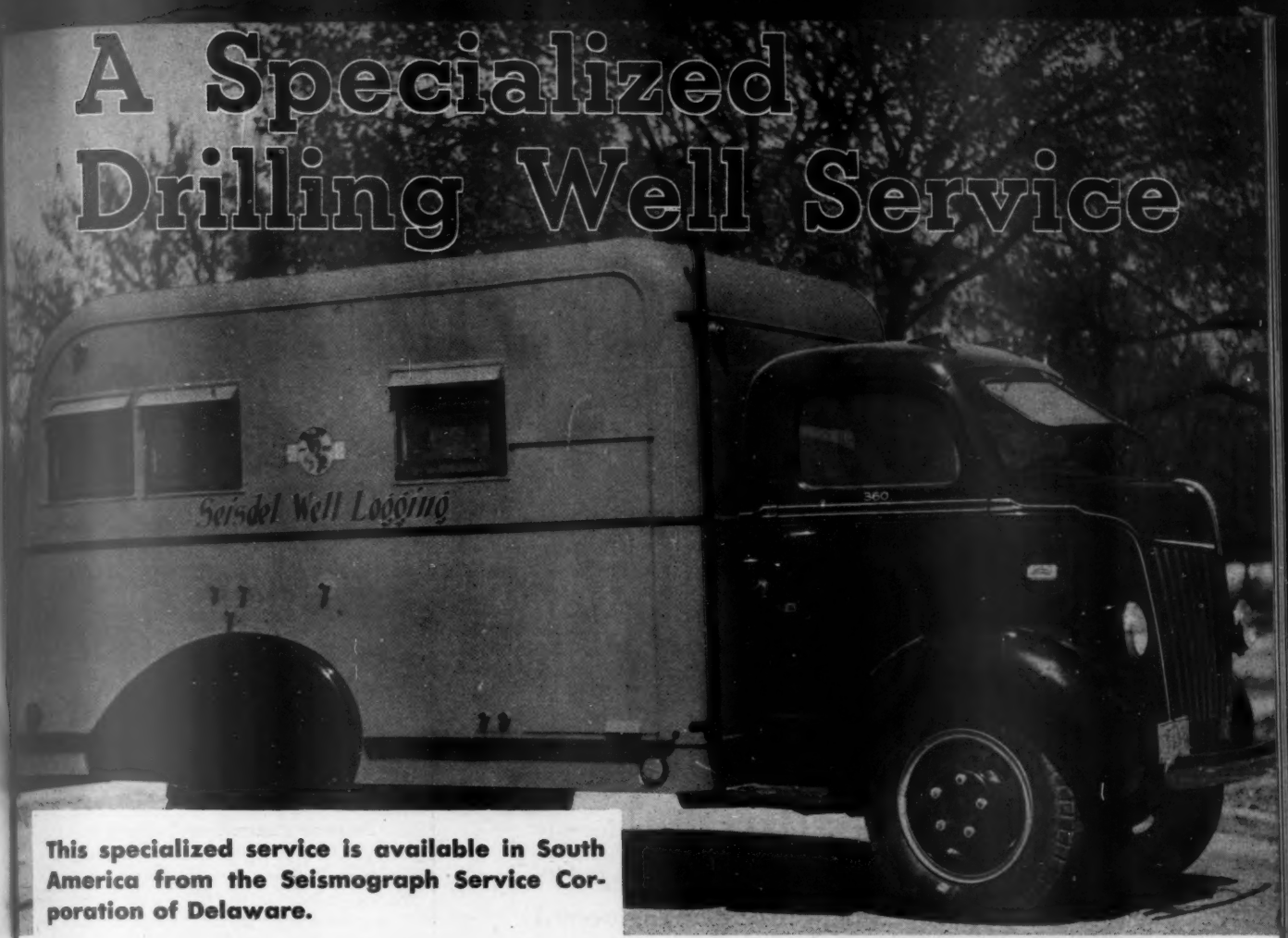


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"The life and soul of science is its practical application."
—Lord Kelvin

1839-1903
Josiah Willard Gibbs was the first physicist to apply the second law of thermodynamics to the exhaustive discussion of the relation between chemical, electrical and thermal energy and capacity for external work.

Gibbs' "Graphical Methods" in the Thermodynamics of Fluids won him fame. In 1901 he was awarded the Copley medal of the Royal Society of London.

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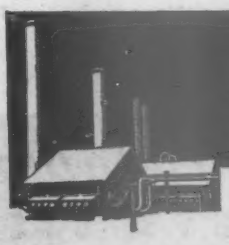

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crease output and enhance critical properties of the products which are indispensable to successful prosecution of the war. In aviation fuels the primary necessity is more miles per hour built into the fuel-engine combination. In synthetic rubber the need is for more miles per tire built into the synthetic product to keep the military machine and its supplying national industries on the move without hitch.

Installation and operating costs have been decidedly secondary considerations so far as immediate units, their building and operation are concerned. Only in postwar planning are costs of major importance, costs in terms of comparison with older processes already adopted by the refiner, in terms of ability of refiners to pay for process units and of the consumer to pay for improved products. Forward look-see at what may follow the wartime activities of the refining industry has been indulged in much more by refinery executives during the last half of this year than had been done previously. Gradually the prospect is becoming clearer and the situation which will face the refiner, especially those not having war-products plants, is being outlined.

### Postwar Controlling Factors

In order that the refiner may compete in the after-war industry he must operate at least some of the new types of processes, especially catalytic cracking units. The controlling factors in that prospect are obvious: (1) How much will be the per-barrel cost of installing such a unit?; and (2) what will be the per-barrel-of-product operating cost of the unit? These answers must be worked out satisfactorily or the small refiner cannot operate "cat" crackers. If he cannot operate these new processes he cannot survive, because of the marked increase in motor and aviation-fuel qualities which probably will follow the war over a period of a few years after peace comes. Thermal cracking processes cannot meet the octane-number competition in motor fuels and especially in aviation fuels, the latter of which has tolerated no thermally cracked material up to the present. Reports say that Canadian aircraft operators have found that thermally cracked fuel is satisfactory for military-training-plane operation, but the practice has not won general acceptance. Octane numbers of around 75 Motor Method are about the highest obtainable by liquid or mixed-phase thermal cracking, with a few units yielding higher-quality products on vapor-phase operation. Catalytic cracking will yield 80-octane-number fuel or higher from the same stocks, with high lead susceptibility. Opinions of qualified refinery executives and technical men are that, within 12 to 24 months after the war's cessa-

tion, release of modern cracking, alkylation and isomerization capacity for civilian and commercial operation, regular motor fuels will show octane numbers between 80 and 90, with premium grades correspondingly higher, or around 90-95 A.S.T.M. Accordingly the average refiner, such as Mid-Continent independents, will be unable to compete for motor-fuel markets unless they operate either a catalytic cracking or an alkylation process.

### Small Plants Problem

If this indication holds, then a catalytic cracking process which is economically practicable for the relatively small refiner with limited resources will be a necessity if those refiners are to survive. Opinion differs as to the feasibility of adapting the three widely installed catalytic processes to small-scale throughputs. History proves continued experience with a new process has reduced first costs and operating expenses and has improved yields and product qualities. This trend is to be expected in the case of new processes hastened in development by the war's demands, but whether or not solutions will be found to the economic problems for the smaller refiners remains to be seen.

Strong claims are made for the possibilities of the Cycloversion process. A fixed-catalyst bed, high temperature of reaction and of regeneration appear to be built on useful principles. It is understood that a large commercial unit is under construction, the operation of which should furnish valuable data. Still another principle, that of the so-called Syspensoid system, already employed by one refiner, is stimulating considerable interest among refiners as another possible solution of the catalytic cracking problem for the small refiner, and experimental work to demonstrate this principle in a practical operation is being considered.

Alkylation has long since won acceptance as a practical operation for the manufacture of a highly indispensable major component of aviation superfuels. Three important catalysts are employed now for this process. The newest one, anhydrous hydrofluoric acid, appears to have the edge in efficiency, judged by the number of units being built as defense projects. More than 30 alkylation units are operating or are currently under construction. The primary advantages of the HF process, it is claimed, are the low temperatures and pressures of the reaction, the ease of recovering the catalyst with very small processing losses, the ease of eliminating catalyst impurities from the product and the high yields so obtained.

As a companion or auxiliary method to alkylation, catalytic isomerization is also increasing rapidly in capacity and importance. As a method for supplying any required amounts of isomer hydrocarbons for alkylation this process is indispensable, otherwise the refiner is at the mercy of

*Hydrogenation is a reaction used widely for production of war fuels, is one of the major principles which may be used to maintain our gasoline supply if and when petroleum reserves become depleted. This unit is the first commercial hydrogenation unit built in America, operates on many types of charge stocks*

the existing naturally occurring isomers and of the available superfractionation facilities for recovering these isomers. Application of the process is twofold, first as a source of isomer charge stock for alkylation, and to improve the octane number and in some measure the volatility of light distillates as ingredients of aviation or motor fuels, as for example the preparation of isopentanes and isohexanes from the normal products. Two processes have been announced without the details of either having been disclosed. The Standard Oil Co. of Indiana and Universal Oil Products Co. isomerization processes are presumably applicable especially for the conversion of distillates as such as well as to prepare charge stocks for alkylation or other processes. The extent of application of isomerization to peacetime operations of the average refinery is still not indicated clearly, and the use of the principle will be governed doubtless by economic considerations. It is one of the most useful reactions yet developed in synthetic-fuel production. In all probability it will find large application in the future in the preparation of intermediates for chemical syntheses in the broader sense.

In another direction the trend is not yet too well defined, but the combination of thermal and catalytic cracking appears to offer the most promising arrangement for the refiner of the future for the manufacture of the superfuels which will power our automotive and aviation equipment. Good fuel technology indicates that in general the light ends of motor fuel should contain appreciable amounts of monoolefins, while the heavy ends should be relatively olefin free, but contain considerable percentages of naphthenes and even aromatics, for best over-all performance. Such requirements indicate that a good combination is thermal cracking or reforming to yield the "front" end of motor fuel, and possibly some part of aviation fuel. Catalytic processes are used to produce the heavy half of the motor fuel to supply the individual components now considered most desirable. The once-through heavy oil from the catalytic cracker can be processed satisfactorily in the thermal unit. The heavier unsaturated or olefinic portion of thermally cracked distillate may be processed either catalytically to dehydrogenate it to naphthenic and aromatic constituents or to hydrogenate it to more saturated isoparaffinic or even paraffinic hydrocarbons.

Some technologists hold that the basic reaction of alkylation, that is, combination of isoparaffins, naphthenes or aromatics, with monoolefins to form complex structured isoparaffins and other products will become a general principle of processing, to react mixtures of these two types of intermediates to yield more complex mixtures of material for tomorrow's fuels.

### Petroleum Substitutes

Among the potential substitutes, coal shows the greatest reserves, with estimated 69,000,000 trillion B.t.u.'s in the coal beds of the United States. Canadian tar sands follow second with 560,000 trillion B.t.u.'s. Third is oil shale in this country, with 514,000 trillion B.t.u.'s. Natural gas reserves promise 100,000 trillion units, while known petroleum deposits offer 112,000 trillion B.t.u.'s as warrant for future fuel supplies.

The U. S. Bureau of Mines is pushing the work of research on coal hydrogenation intensively with a pilot plant and staff at the Pittsburgh, Pa., station. Plans are under way for the bureau to resume the experimental work on oil shale, interrupted in 1929 when appropriations were suspended. Additional research on other processes may be undertaken depending on the attitude of Congress. Canadian industrialists are operating units in extracting the tars or heavy hydrocarbon deposits in the Athabasca sands.

By the various methods for obtaining hydrocarbon products from these raw materials, the best estimates indicate an installation (investment) cost for fuel from coal by hydrogenation at nearly $13,000 per barrel of daily gasoline output. To produce a million barrels of motor fuel per day in this manner would cost, therefore, nearly 13 billion dollars in investment. If the fuel is obtained by the Fischer-Tropsch synthesis from coal, the investment is reduced to 7.6 billion dollars. Without including a profit of any caliber for the refiner the national gasoline bill would be 5.7 billion dollars annually from coal-hydrogenated gasoline, or 4.7 billion dollars by the Fischer-Tropsch process. Using natural gas, an investment of 4.75 billion dollars in the Fischer-Tropsch process will yield our annual gasoline requirements at a cost of 2.5 billion dollars. Hydrogenation of petroleum stocks with an investment of 1.15 billion dollars will yield United States gasoline requirements for 1.44 billion dollars; for the same purchase cost (1.44 billion dollars), using present refining methods the plant investment cost is estimated at only 0.7 billion dollars.

Obviously the method or methods actually used at any future date will be dictated by the economics of processes. For the immediate future, interest of the oil industry is concentrated on two major fields: (1) the finding and production of additional supplies of crude, and (2) the methods most useful in the production, and the efficient application of processes.


A Happy and Safe New Year

To those who serve us
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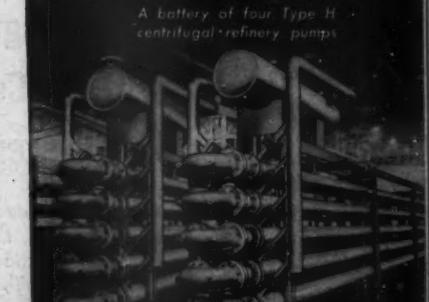

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*Welding War Emergency Pipelines, Inc. 24-in. crude-oil line at a section in hilly country of Pennsylvania*

# Larger Lines Feature Transportation

**by Paul Reed**

PROJECTS designed specifically to meet wartime demands have been put in operation in 1943. The most conspicuous of these wartime transportation facilities added in the United States are the 1,252-mile system, mostly of 24-in. pipe, for crude oil from Texas to the East Coast, and the 1,640-mile line, mostly of 20-in. pipe, for refined products from the Gulf Coast to the eastern seaboard. Other notable developments are the building of two refined products lines, mostly of 10-in. pipe, together with a considerable amount of other equipment, most of which was salvaged from crude-oil systems.

For strictly military purposes, equipment has been made for service with portable lines of light-weight pipe, joined by bolted couplings, which has been used for distances of more than 100 miles in theaters of war for supplying airplanes and motorized military equipment.

There has been much discussion of the low cost of moving crude oil through the long 24-in. crude-oil line. According to estimates of engineers, transportation costs through this system will be the lowest ever attained by pipe lines. Experience in operating the section of 531 miles where facilities of this project were first completed confirms the belief that the line will effectively compete with tankers which must follow an 1,885-mile route from the Gulf Coast to New York.

### Operating Cost Factors

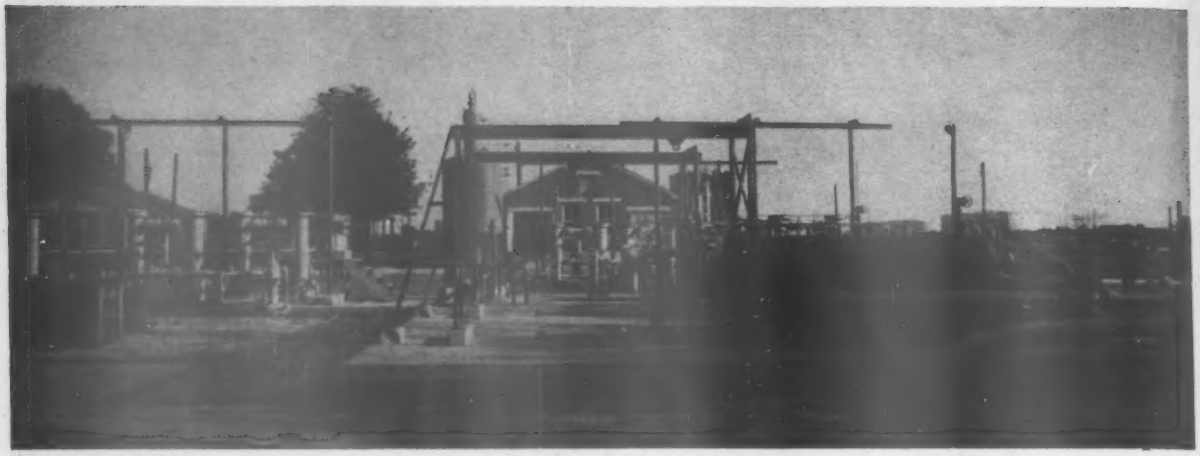
In addition to an electric-power expense of 5.7 cents per barrel, other charges, including depreciation at 5 per cent, expenses for operating personnel, maintenance and supplies brought the total cost of moving a barrel the 1,252-mile distance up to 13 cents, when the throughput is 300,000 bbl. daily at 100 per cent load factor.

Construction costs have been less than original estimates of $95,000,000 and some calculations of transportation costs have been as low as about 10 cents per barrel, exclusive of taxes which would be incurred if the line were operated by a private company.

The practice of using large-diameter pipe for petroleum lines has spread to a 385-mile, 16-in. crude-oil line from Texas to Oklahoma, now under construction. Before the war there was no extensive line larger than 12-in., except the 16-in. of Mene Grande Oil Co. in Venezuela, built several years ago.

Methods for batching crude oil and products through pipe lines have received much attention recently. Segregation of crudes to improve refinery operation and the trend of recent years toward shipping more No. 2 heating oil through refined products lines have stimulated study of efficient procedures.

Although devices, variously referred to as scrapers, plugs and pigs, were formerly used extensively between batches of different grades, they have been largely discontinued.



*Terminal of Bayou Pipe Line Co.'s system with meters on feeder lines, filter tanks known as hay tanks, scraper trap, and pump house*

However, they are used now on certain large systems, including the new 24-in. crude-oil line. To avoid excessive wear on the bottom of the interior wall of the pipe, a flotation-type scraper has been developed for the 24-in. crude-oil line and the 20-in. products line. This is practicable for lines of diameters as small as 16 in. Such a scraper is built around an air chamber which provides sufficient buoyancy to substantially reduce the effective weight of the scraper while it passes through the line.

Most lines, whether running crude oil or products, which transport several grades, eliminate objectionable contamination between batches by maintaining pressure sufficiently high to avoid laminar conditions of fluid as well as by operating with the fewest possible interruptions to flow and by making shipments in large batches.

Gravitometers have been widely used during the past year at both crude-oil and product-line terminals for accurate determination of the point of contact between batches. The instrument gives a continuous record of gravity of fluids flowing through a line. Such determinations continue to be made at stations by hydrometer tests. Experiments are under way using flash tests at terminals to determine arrival of heating oil.

### "Carry Ahead" Method

A crude-oil pipe line has obtained satisfactory results with what is called the "carry ahead" method which increases throughput when batches of different viscosities are transported. With this method, less viscous, faster flowing oil is permitted to flow into a tank at each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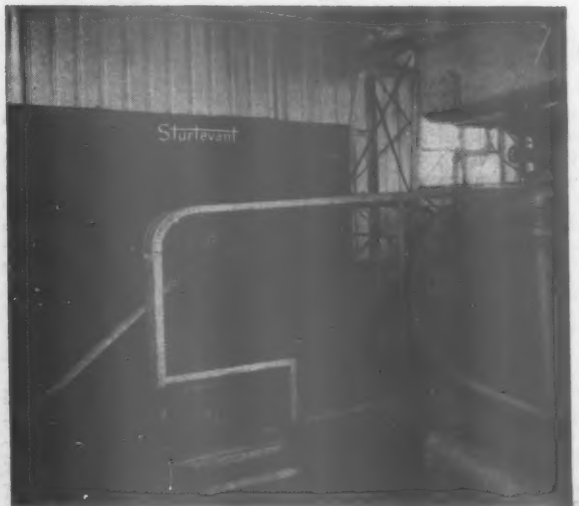


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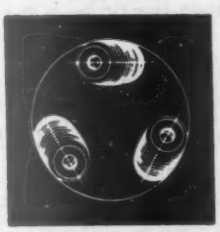
*Puts Air to Work*

# What this BARREL SHAPE means in *Stabilization!*

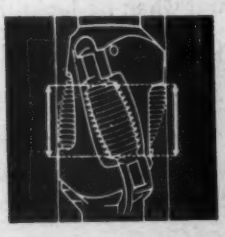
**The barrel shape of Sievers cutters and the engineered angle at which they are mounted, imparts a combination shearing and crushing action which eliminates vibration and gives full hole stabilization:**

**THREE barrel shaped cutters having continuous contact with 30%-35% of the circumference of the hole steadies the drill string from all directions and eliminates "whipping." This centering of the bit to its true axis, even in the toughest going, enables the Sievers Reamer to provide full hole stabilization at all times. Various cutter types are made to meet all conditions.**

**The upward lift of the cutters, due to the angle of shear, cause a slight downward pressure on the drill string . . . steadies its rotation . . . assists in holding the bit on a straight course under fast drilling.**



**In this view looking down on the Sievers reamer notice how the barrel-shaped cutters are in continuous contact with 30%-35% of the circumference of the hole. This assures round, full gauge hole.**



**This side view of the Sievers Reamer shows not only an extraordinary amount of contact around the hole, but also ample contact up and down the hole. This means the Sievers Reamer effectively resists vibration from both vertical and horizontal directions.**

**WIDE WALL CONTACT MEANS FULL HOLE *Stabilization!***

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Photo courtesy of U. S. Rubber Co.

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When an operator casts his eyes at the gage on a column or tank to note the liquid level, he wants to be *sure* of what he is seeing.

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That calls for durability.

Industry, including the petroleum industry in all its ramifications, has come to look upon the Jerguson Gage as standard for the important work of informing plant operators of the liquid level status in the many types of towers, tanks and columns being used.

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station while such a grade is passing through the line behind the slower moving, more viscous oil. When a new batch of the more viscous oil enters the line, the less viscous oil is gradually withdrawn from tanks, starting with those at stations furthest upstream.

New relationships are now recognized between crude-oil lines and natural-gas lines because of various undertakings in the last 2 years. One company has been successful in simultaneously transporting light oil and gas through a 28-mile, 8-in. line. Another company has recently embarked on an unusual program which calls for utilizing a natural-gas line for solving a particular crude-oil transportation problem.

### Reconditioning of Lines

Surplus oil is stored. Every 2 months it is to be moved through a line formerly used for crude oil but which has been utilized for gas in recent years. In the intervening time, when the line is not transporting crude oil, it will be operated in natural-gas-transmission service. War conditions have brought about conversion of several natural-gas lines to exclusive movement of crude oil. Usually such lines must be thoroughly reconditioned before this change is made. At one project of this kind all pipe was taken from the ground, bolted couplings removed, pipe cleaned, spot welded, patched, double jointed, coated and wrapped before being welded into the line. Because of the expense of the operation it is regarded as a measure which would only be adopted for a wartime government program.

An effective method was adopted for reconditioning an 87-mile section of a 10-in. line while it was almost continually operated for the vital service of feeding the 24-in. crude-oil line from Texas to the East Coast. The task was handled by installing a 10-mile loop to function where corroded pipe is dug up and moved to a reconditioning yard before replacement in good condition further along the line. Originally it was intended that the work would be done in 20-mile sections, but the 10-mile section was found to be more practicable. The wisdom of this procedure which permits the complete removal of the pipe has been attested by experience with this project where pipe broke several times while it was being dug up. There have been numerous instances where reconditioning of lines has been conducted over the ditches while the lines continued in active service.

Reconditioning of sections of pipe for distances of several miles was more commonly practiced several years ago than currently. Study of costs indicated that it is usually more economical to install sound joints in the badly corroded sections. Because of the peculiar nature of the corrosion of the 87-mile, 10-in. pipe line referred to, extensive reconditioning was necessary.

In this case, since the product of corrosion deposited on the pipe was of a kind which interferred with the application of cathodic protection, it was found necessary to not only clean the pipe with machines applying cutter wheels but also by grit-cleaning machines, applying shot blasting.

### Locating Corrosion

By means of a careful record of maintenance work performed on a major company system, it has been found that corrosion surveys with electric-current meters have been successful in locating many corrosive areas that would not otherwise have been detected.

Since the electric potential between the pipe and a copper-sulfate electrode with no current flow will vary with different types of soils, because of the liquid-junction potential, no definite value of pipe-to-soil potential can be set to determine that point at which corrosion will occur. But by measuring pipe-to-soil potential at regular intervals along a pipe line under the same conditions, experience has shown that at points where corrosion is definitely occurring there will be a decided increase or peak in pipe-to-soil potential values as read with a copper-sulfate electrode. Pipe-to-soil potentials plotted graphically along the line at points where observations are regularly made will almost always show a peak in the pipe-to-soil potentials where corrosion is most severe. However, a severely corrosive condition is not always found at all such peaks in the pipe-to-soil potentials.

Inasmuch as corrosion is regarded as electro-chemical in nature, any corrosion is accompanied by electric currents. There is difference of opinion

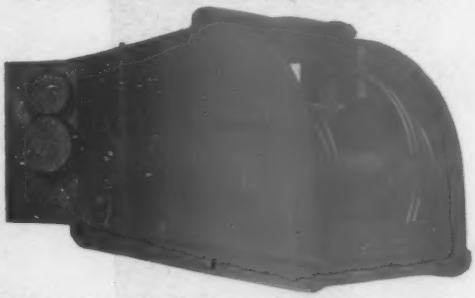
*(Continued on page 198)*

***Right: Centrifugal pumps operating in series to handle 60,000 bbl. daily of crude oil are installed in floor space of 880 sq. ft.***

***Below: Compact pump station of Texas-New Mexico Pipe Line Co. equipped with four natural-gas engines, one of which serves as a standby while three pump with a total capacity of 17,000 bbl. daily***

# *La pistola de perforación* LANE-WELLS *representa seguridad, exactitud y mayor penetración con perforación selectiva*

El camión especial de servicio Lane-Wells, con montacargas y sistemas de gobierno mecánico y eléctrico construidos a la orden. Se usa para la perforación con pistola, cuando este trabajo se hace periodicamente, en grande escala, durante un largo período de tiempo.



Pistola de perforación Lane-Wells, montada en patín, para instalación sobre base plana o cualquiera marca de camión o barca. Completa en todo detalle mecánico y eléctrico.

**Las pistolas de perforación Lane-Wells disponibles al presente, están proyectadas y equipadas para proveer una perforación selectiva de la tubería y forro. Cada tiro se apunta exactamente mediante dispositivos visuales de registro, medición de profundidad e indicación de peso. Un quíntuple sistema de seguridad da protección a los operarios y equipo. El tipo y construcción de las cámaras asegura utilización máxima de la fuerza de la pólvora, para proveer mayor penetración de la formación a través de múltiples series de tubería.**

**Incondicionalmente enviaremos, a solicitud, información completa sobre las pistolas de perforación Lane-Wells y de sus aplicaciones a más de 45.000 trabajos satisfactorios. Sírvase escribir a la Lane-Wells Company, 5610 South Soto Street, Los Angeles 11, California, E.U.A.**

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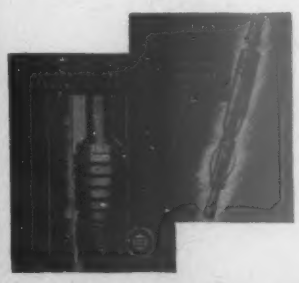
**Los obturadores o tapones Lane-Wells Quite-Seal y Olympic se ofrecen en tamaños y tipos para satisfacer cualquiera condición de pozo que se presente. Estos excelentes obturadores han venido trabajando satisfactoriamente desde hace cerca de veinte años. Gratuita e incondicionalmente enviaremos, a quien la pida, información completa, incluyendo descripción, características, precios, datos técnicos y aplicación a los problemas de los campos petrolíferos latinoamericanos.**

**Lane-Wells Gun Perforator Units now available are designed and equipped to provide selective perforation of casing and liner. Visual registering, depth measuring and weight indicating devices locate accurately each shot. A five-fold safety system protects men and equipment. The design and construction of the chambers assures maximum utilization of the power of the burning powder to provide greater penetration of formation through multiple strings of casing.**

**Complete information about Lane-Wells Gun Perforator Units and Gun Perforator application on more than 45,000 successful jobs is available without obligation. Write Lane-Wells Company, 5610 South Soto Street, Los Angeles 11, California.**



**PIDA LOS BOLETINES**

LANE-WELLS COMPANY — TECHNICAL OIL FIELD SERVICES

**Fábrica y oficinas generales Los Angeles 11, California, U. S. A.**

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**¡ Las herramientas de Mañana-Hoy !**

# These LANE-WELLS Packers

## Meet Every Operating Requirement At The Lowest Cost Per Barrel of Production

You will find a Quinta-Seal Packer or an Olympic Packer that will give you the most efficient service because each of the fourteen types of Lane-Wells Packers was designed and built to solve successfully a particular set of well conditions. Each Packer has been thoroughly proved by years of service in the field. All are characterized by these advantages:

MULTIPLE RING SAFETY SEAL-OFF · FLAT SIDE RINGS
EASIER RUNNING · GREATER APPLICATION FLEXIBILITY
INCREASED CIRCULATION · MINIMUM SWABBING ACTION
EXTRA LARGE SLIP AREA
INSIDE DIAMETER SAME AS TUBING
EASILY REPAIRED IN THE FIELD
STOCKS AVAILABLE IN MOST DOMESTIC FIELDS

**QUINTA SEAL PACKERS**

For dependable performance under severe well conditions. Positive seal and resistance to high gas pressure. Circulation is large enough to permit operation at normal speeds.

**OLYMPIC PACKERS**

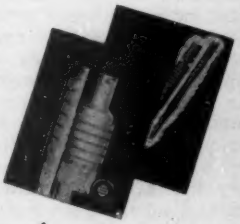
Designed for successful operations under extreme conditions. Rings are built to meet formation testing specifications. Dove-tailed slips and free-wheeling cage permits use in deviated wells.

Lane-Wells Packers more than pay their way today because they can be set and reset as often as required.

**In 15 Years they "Haven't Stuck Yet"**

**SEND FOR THESE BULLETINS**

Specifications and applications of Lane-Wells Packers tell how they prolong flowing life and cut production costs. Write today.



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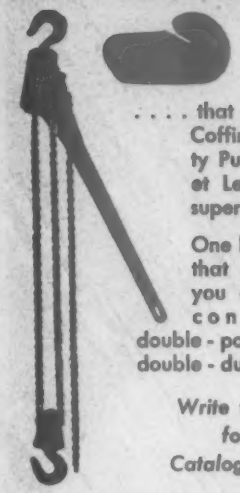

. . . . that gives the Coffing "Safety Pull" Ratchet Lever Hoist superiority.

One little hook that will give you an easily converted double-power and double-duty hoist.

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**COFFING HOIST CO.**

*Manufacturers of*

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**CURTIN CENTRIFUGES**

*GIVE YOU QUICK, ACCURATE RESULTS WITH LESS EFFORT . . . AT LESS COST*

Simple in design, ruggedly built for heavy duty service. Gear ratio and throw of crank produce required speed with no strain. Heads and cranks of 100 CC and 15 CC machines are interchangeable. Meets *A.S.T.M. Standard Method D-96* and *A.P.I. Code No. 25* requirements. Ask for full details.

**W·H·CURTIN & CO. Inc**

HOUSTON U.S.A. TEXAS

*Pump station of Bayou Pipe Line Co. with pump house surrounded by 1,000 kva., 33,000/2,300-volt unit-type substation, bypass valves, twin-basket strainers, automatic-control valves, and sump pump*

*(Continued from page 195)*

as to whether the currents are the cause or the result of corrosion, but it is recognized that one cannot exist without the other. Where currents discharge there is corrosion. Therefore, by fixing discharge points, the location of corrosion can be determined.

### Salvaging Pipe and Fittings

Salvaging of pipe and fittings has become more important during wartime when new equipment is hard to obtain. A procedure for reconditioning pipe on the Gulf Coast starts with burning off old coating and oil by flames from gas-fired nozzles which heat just below redness. Rust is loosened for fast cleaning. After sandblasting and inspecting, pipe is graded, spot welded and double jointed. Large pipe is primed with a spray gun, one joint at a time. Several joints of smaller pipe may be sprayed at one time.

Heavy duty lathes and drill presses have been effective in repairing gate valves. After being sandblasted and disassembled, disks are ground under kerosene by the use of emery paper on a flat head attached to a drill press. If necessary, a new seat is brazed on the disk and turned in the lathe or an entirely new disk may be installed. Seat rings are also ground under kerosene with emery paper backed by a machine disk or the valve may be given new seat rings. Valve stems are repaired by various processes and after reassembly, using new gaskets and packing, they are given a hydraulic test at one and a half times the rated working pressure.

A temporary expedient for stopping leaks in large storage tanks at terminals has proven effective. This consists of injecting sheep manure into the top of such a tank through a hopper placed over a manhole. An air compressor connected with the hopper equipment blows the manure into the tank. The hose connecting the air compressor and the hopper is grounded to the shell of the tank by copper wire to eliminate fire hazard. For actually closing the leak only a bucketful of manure may be necessary but in order to make certain that the manure reaches the leak where it is needed, 50 to 100 sacks may be put into the tank.

### Pumping Equipment

Electric centrifugal pumping units have been installed extensively on lines built to meet wartime needs. The choice of this equipment was influenced by difficulty in procuring equipment of other types. Each unit, connected in series, has a large single-stage, centrifugal pump. The pumps have the remarkably high efficiency of 86 per cent which approaches the efficiency of positive-displacement plunger pumps. This is 8 per cent more than what has been regarded previously as high efficiency.

An unusual pump installation has been made within the last few weeks at a major company crude-oil station in Texas where an 800-hp. vertical, inverted, quintuplex, reciprocating pump, designed to operate at 155 r.p.m. and higher is direct-connected to a diesel engine by means of a floating shaft. No reduction gears will be used between the engine and pump.

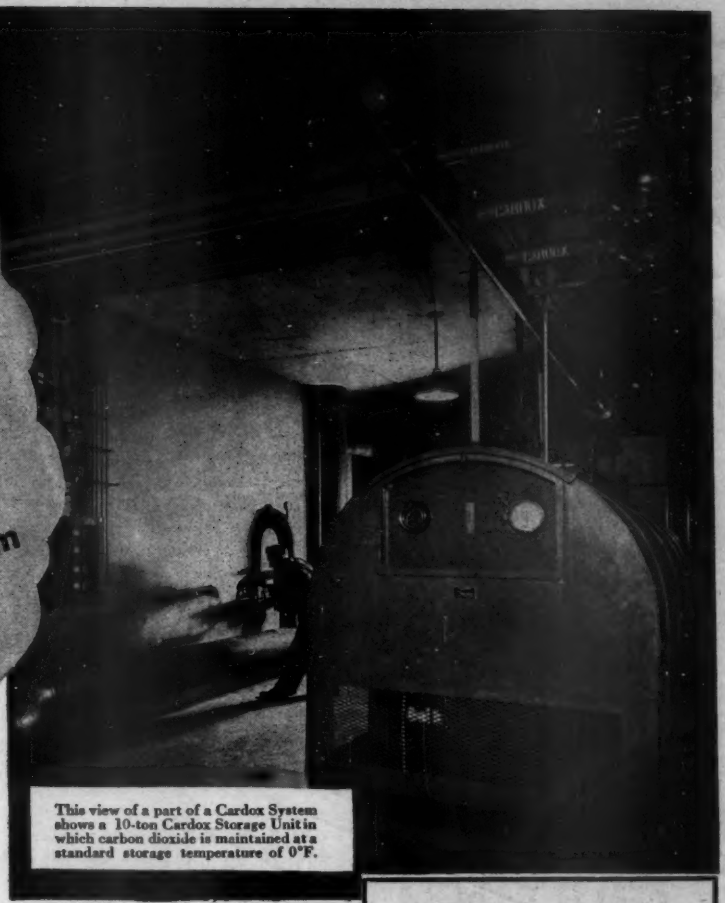
### Pipe-Line Construction

In pipe-line construction the outstanding achievements of the year have been the building of the 24-in. crude-oil line and the 20-in. refined-products line over terrain varying from the swamps of the Gulf Coast to the mountains of Pennsylvania.

The chief innovation developed for these projects has been the bending jig mounted on a heavy frame dragged along the right-of-way on skids. The principal feature is a series of 20 hinged shoes against which pipe is held while it is bent. This device has effected considerable savings in bending large-diameter pipe.

The most spectacular part of building the 24-in. and 20-in. lines has been the laying of pipe across major rivers such as the Arkansas, Mississippi, Ohio and Susquehanna, as well as difficult ones as the Youghiogheny Gorge in western Pennsylvania.

# Tough Fire Hazards "Engineered" this CARDOX Fire Extinguishing System



This view of a part of a Cardox System shows a 10-ton Cardox Storage Unit in which carbon dioxide is maintained at a standard storage temperature of 0°F.

Hazards in this plant involve the extensive use of flashy flammable liquids. Unless extinguished in a few seconds, fire could mean the total loss of precious materials and skilled man-hours.

Protection for these hazards is provided by a Cardox System . . . individually engineered to give the most effective application of Cardox $CO_2$ for the specific hazards protected by the system.

### How This Cardox System Performs

Fire in any of these hazards is detected visually or automatically.

An alarm sounds, giving personnel notice to leave the fire zone. Time is allowed for complete evacuation of personnel.

A timed, *mass* discharge of cold Cardox $CO_2$, released into the fire zone, reduces oxygen content of the atmosphere below combustion requirements and cools out the entire fire. So rapidly is the Cardox $CO_2$ discharged into the fire that burning time is usually cut to a very few seconds.

Since Cardox $CO_2$ is a non-damaging, non-contaminating inert gas, there is no damage or production delay caused by the extinguishing medium.

### How Cardox Systems Provide Uniform Performance

Extinguishment of this kind is possible with a Cardox System, through engineered application of carbon dioxide maintained at a standard storage temperature of 0°F. Cardox $CO_2$ extinguishing performance is uniform, regardless of weather or plant operating temperature.

The advantage of uniform extinguishing performance can thus be provided in small or large systems, whether engineered for one or a number of hazards —indoors or out.

Convenient hose reels can be included in the system for fire that would call for local direct application of Cardox $CO_2$. For example, loading or unloading volatile and flammable liquids.

If you would like more information to help solve war plant fire protection problems of today . . . or in perfecting post-war plans for reducing loss of property and life by fire—write for Bulletin 23123.

★ ★ ★

**CARDOX CORPORATION**

**BELL BUILDING • CHICAGO 1, ILLINOIS**

*District Offices in* New York • Washington
Detroit • Cleveland • Atlanta • Pittsburgh
San Francisco • Los Angeles • Seattle

### How Cardox Systems Protect War Industries

- Timed discharges, as needed, through built-in piping systems . . . supplied instantly from a single storage unit holding tons (if required) of liquid Cardox $CO_2$.
- Mass discharge of Cardox $CO_2$ "knocks out" fire, by . . .
- Reducing oxygen content of the atmosphere below the concentration necessary for combustion, and . . .
- Cooling combustibles and fire zone below ignition temperature . . .
- Extinguishing fire quickly and completely *without* damage from extinguishing medium.

**CARDOX—$CO_2$ Systems with Enhanced Fire Extinguishing Performance**

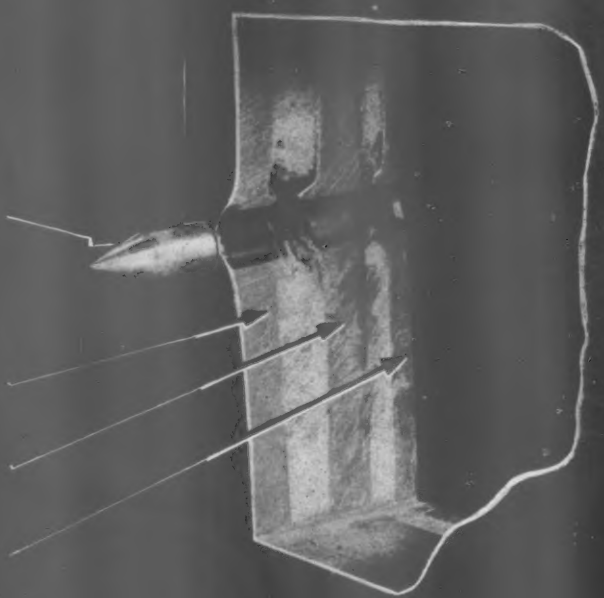
A. Uniformity of $CO_2$ characteristics.
B. Extinguishing medium with uniformly greater cooling effect.
C. Accurate projection of $CO_2$ through greater distances.
D. Timed discharges, as needed, through built-in piping systems . . . supplied quickly from a single tank holding tons of liquid Cardox $CO_2$.

ENHANCED COOLING EFFECT · CENTRAL STORAGE UNIT · AMPLE $CO_2$ RESERVE · ENGINEERED SYSTEMS · MANUAL AUTOMATIC

**CARDOX**

**NON-DAMAGING FIRE EXTINGUISHING SYSTEMS**

# POWER TO SPARE



Unretouched photograph of a standard Schlumberger ½-in. bullet after penetrating three joints of cemented casing and partially penetrating a joint of protector pipe.

8⅝", 36 lb. casing, Grade N-40. Brinell Hardness—116.

6⅝", 28 lb. casing, Grade N-80. Brinell Hardness—196.

5", 15 lb. casing, Grade N-80. Brinell Hardness—207.

To test the perforating power of Schlumberger guns under the actual pressure and temperature conditions encountered in the average ten thousand foot well, Schlumberger engineers cemented three sections of casing, placed them in a scientifically designed test chamber where the temperature and pressure were raised to 265° F. and 6000 lbs. p.s.i. respectively, and fired a standard 4-inch Schlumberger gun charged with 390 grains of powder.* This unretouched photograph of the clean, straight perforations through the 1 ⅛" of steel and ⅞" of hard cement clearly demonstrates that the industry's most precise gun perforator is also one of the most powerful.

Complete details and photographs relative to this test will gladly be sent to interested operators on request.

*One of the two standard Schlumberger loads.

## SCHLUMBERGER WELL SURVEYING CORPORATION

HOUSTON, TEXAS

# Recovery of Isobutane Forces Sharp Change in Natural-Gasoline Plants

*by H. Stanley Norman*

URGENCY for production of sufficient isobutane to accommodate the rapidly expanding alkylation capacity resulted this year in the most evolutionary change ever experienced in a comparable period by the natural-gasoline industry. Installation of the facilities required to recover isobutane in various degrees of purity qualifies the industry for continued participation in the function of supplying a much wider variety of hydrocarbons that doubtless will occupy postwar roles in the chemical and allied industries.

Only slightly less urgent in the war assignment of the natural-gasoline manufacturers is the maximum recovery of isopentane which has superior inherent characteristics of desirable octane number and vapor pressure. Isopentane has the highest blending octane number, 103.5, of any hydrocarbon available in reasonably high percentage from natural gasoline and boils at 82.4° F., which is practically ideal for the so-called "front end" of aviation gasoline.

### War Multiples Demand

Demand for isobutane from natural-gasoline plants to supplement volumes produced in refinery-cracking operations started upward with commercial development of alkylation 5 years ago. But the requirements in this keystone process of the aviation-gasoline program skyrocketed to a critical level with each successive increment in the production goals for military fuel. The quickest and most logical instrumentality for supplementing supplies of isobutane, government and industry authorities determined, was by segregation of this hydrocarbon from field production of natural gasoline and cycle-plant products. Consequently, the industry this year worked under pressure of all the influence that could be exerted by government agencies directing the petroleum war program for constant expansion of isobutane production, to the virtual exclusion of economic considerations.

The $C_4$ fraction from conventional natural gasoline plants have been shipped, in some instances, hundreds of miles via tank cars, pipe lines and motor transport for separation of normal and isobutane at competitive plants which happened to have excess splitter capacity already installed. Butane, available in much higher percentages from thermal and catalytic-cracking operations, is rapidly becoming an almost equally valuable product, if economics are ignored, because of the installation of isomerization plants in which the normal fraction is converted to isobutane at rates up to 98 per cent of the charge.

### Ingenuity Plays Part

Much ingenuity has entered into the engineering aspects of multiplying the capacity for manufacture of isobutane. Plant operators, in many instances, discontinued operation of less critical facilities in order to make towers and other equipment available for installation of butane-mixture splitters. One company dismantled two conventional stabilizers, welded the columns together, and installed the required number of additional plates, using only incidental amounts of new critical materials.

Efficient fractionation of isobutane requires towers up to 75 ft. or higher and from 50 to 80 plates. The greater the number of trays the more efficient the fractionation and resultant purity of product. Critical shortages of equipment prevailing now and during earlier stages of the natural-gasoline-plant construction program forced many operators to compromise between optimum facilities and those available for prompt installation. On the other hand, much of the current construction activity could not be justified on the basis of peacetime economy, which probably compensates to some degree for the inability of manufacturers to obtain equipment

*Sharp contrast between the equipment in this modern natural-gasoline plant and the conventional prewar units features the isobutane column, the tallest vessel in the photo*

# *It takes* POWER *to produce fighting Power*

## VITAL INDUSTRIES FIND UTILITY ELECTRIC POWER AN EVER-READY, DEPENDABLE COMRADE!

The increased consumption of Utility Electric Power since the war is startling—many times greater than that during World War No. 1. Even so, considering this constant, tremendous increase in demand, it *has not* been necessary to ration UTILITY ELECTRIC POWER, because the many inter-connected companies, forming the world's best operated power system, have been able to supply plenty of Electric Power to meet every vital need. In other words, UTILITY ELECTRIC POWER is essential to the production of fighting power—gasoline, oil, and synthetic rubber. Think how important, then, these facilities and this service can be to you—after the war.

*Use Utility Electric Power!*

PETROLEUM ELECTRIC POWER ASSOCIATION

Box 1498, Oklahoma City, Oklahoma

for "ideal" plants in all instances.

Emergency requirements for maximum production of isobutane and other aviation-gasoline components have focused a large part of the current and near-future expenditures in the natural gasoline and cycling industry in Texas where a majority of condensate fields are situated. The program determination by the Petroleum Administration for War calls for new cycling-plant facilities capable of producing 35,000 bbl. daily of additional condensate, natural gasoline and lighter hydrocarbons. The estimated capital investment, according to James E. Pew, director of PAW's Natural Gas and Natural Gasoline Division, is $28,800,000, of which $10,800,000 is earmarked for the cost of new producing wells. Critical materials required to complete the entire program, including new wells, necessary pipe lines and plant facilities, are estimated by the same authority at 58,350 tons, of which 28,350 tons will be utilized in well completions. Additional reason for concentrating wartime construction of isobutane and isopentane-recovery equipment in the condensate-producing areas is that opportunities for expansion are superior in this segment of the industry. The relative smallness of newly discovered oil fields is not particularly inducive to construction of basic natural-gasoline plants. Furthermore, current restrictions on spacing of development wells and careful control of gas-oil ratios have a tendency to minimize the wet gas charge stock previously available in the larger and more intensely developed fields. Cycling-plant production will total about 40 per cent of all natural gasoline and allied materials by the end of 1944.

### Demand Rising Rapidly

Basically, the rapidly expanding demand for isobutane is an outgrowth of the construction of numerous catalytic-cracking plants. The modern catalytic-cracking plants produce large quantities of propylenes, butylenes, and amylenes. Alkylation of these olefins requires larger quantities of isobutane than are currently available in the field plants and refineries. In alkylating propylenes and amylenes which are normal products in the catalytic-cracking processes, requirements for isobutane are 18 times greater than the yields of the latter product from thermal cracking. The justification for using these exorbitant quantities of isobutane is that yields of aviation alkylate are seven times greater under these optimum conditions than was possible under the original hot sulfuric acid technique of manufacturing isooctane.

Complex fractionation is the most difficult phase of the isobutane program, involving temperature, pressure and reflux controls much more exacting than in any other stage of manufacturing natural gasoline. Maximum results from a fixed capacity for alkylation are obtained with relatively pure isobutane. Consequently, the efficiency of equipment in removing all butane has a direct bearing on production of aviation gasoline, and on the market value of isobutane. Butane has no objectionable reaction in the process but it acts as a diluent and its presence in the alkylation feed either reduces production of aviation alkylate or requires additional capacity for tolerating its passage through the plant.

Isobutane in a composite California unstabilized natural gasoline boils at 13.5° F., while normal butane boils at 31°, indicating the close control and precise fractionation required to recover the two closely associated hydrocarbons in relatively high degrees of purity. At a Mid-Continent plant, the manufacturer has determined that a variation of as little as 3° in temperature variation permitted 10 per cent of the isobutane contained in the normal butane mixture to exit from the base of the tower. Some feed stock of a normal butane mixture contains no more than 10 per cent isobutane before entering the splitter which serves to indicate the necessity for precise control of tower conditions in order to obtain maximum production of isobutane.

Pressure variations between the top and bottom of isobutane towers are

*Partial enclosure of the fractionating columns in natural-gasoline plants has been found to aid in the necessary delicate control of temperatures*

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sufficient to result in serious deviation in operation if the control is established at a point other than the lower part of the fractionator. In ordinary stabilizer operation, pressure control at the top of the tower is satisfactory.

Another important variation in control of isobutane towers is location of the reflux regulator. Conventional stabilizer control provides for a fixed rate of reflux by means of a flow regulator. Withdrawal of condensed overhead from the reflux tank is regulated by a level controller. Changes in the composition of feed stock to the butane-isobutane splitter, using conventional reflux-control equipment and usual installation, may result in cycle operation in which the specification of products varies widely. More exact methods of controlling reflux are required because the cycle action causes wide variation in the volume of isobutane passing overhead which has a direct relation to the percentage contained in the feed stock entering the fractionator. This hazard in successful operation is particularly acute under existing conditions in which practically every splitter in service is fractionating stocks from multiple sources.

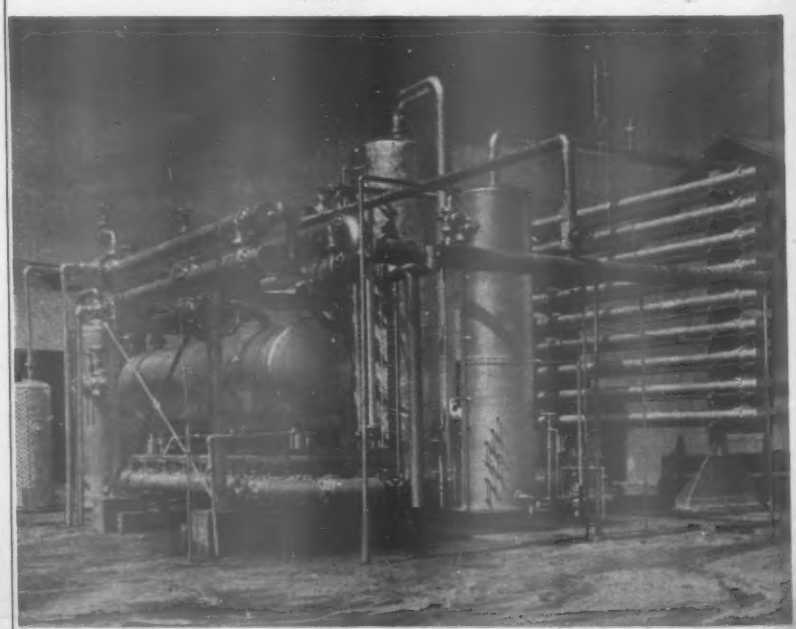
One Texas plant, with facilities to produce a full range of products lighter than isopentane with all heavier hydrocarbons emerging as residual material, is drawing feed stock from five conventional absorption-type plants. Possibly because of the wide variety of charging stock, isobutane from this plant is subject to further purification at refineries where it is used and at points where a high degree of purity is required for maximum production in alkylation processing.

Potential operating hazards from the cycling tendency are eliminated or reduced to a minimum by making reflux control a function of the rate of withdrawal of overhead products. This system maintains the rate of reflux at approximately constant ratio despite the actual rate of withdrawals from the tower. As long as the rate of reflux is maintained at a fixed ratio to the isobutane in the raw charge or even decreases slightly there is comparatively little trouble in accurate control of overhead specifications.

Much research work is currently under way on development of transportation and storage facilities capable of handling hydrocarbons in natural gasoline lighter than propane. The large quantities of liquid ethane-propane mixtures currently separated in cycling operators but returned to the producing horizons in the absence of a market will contribute, petroleum and chemical engineers assert, to the general hydrocarbon economy in the near future. This fraction of condensable liquids, obtainable in natural-gasoline operations as well as in condensate processing, may conceivably enter into any one or several of the potential markets.

### Lighter Gases Studied

Ethane-propane mixtures are potentially valuable in the manufacture of carbon black from liquid hydrocarbons. Experimental work has

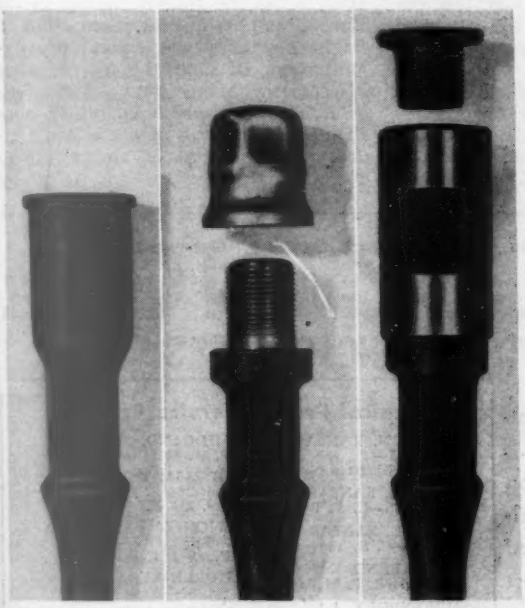


*An absorption-oil cooling system in which butanes and propanes are circulated through coils as the medium for reducing temperatures of fractionation-tower products*

# Sucker Rod Specialists For 52 Years !

Engaged in the invention, improvement and manufacture of sucker rods since 1891, this company developed the first all-metal rod, the first streamlined forging and normalized rod. Laboratory Research through advanced Engineering and Metallurgy, and pioneering of Well Studies are also achievements of the S. M. Jones organization.

Combining engineering design and practical field experience, skilled workmanship and modern plant facilities has enabled the Jones company to produce JoneSuckeRods that have embodied perfection and performance in the oil fields of the world. On the toughest wells, under the most unfavorable field and operating conditions, JoneSuckeRods have produced literally millions of barrels of oil without a failure.



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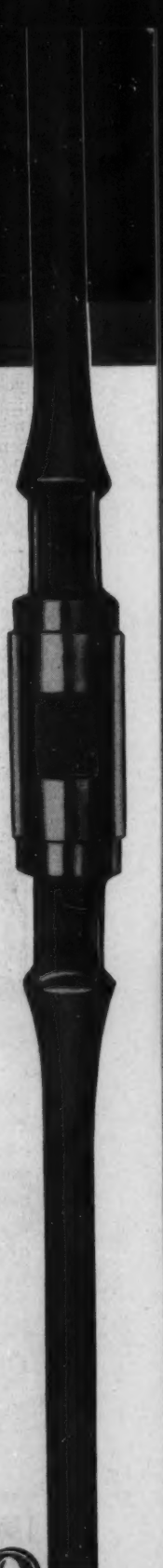
- **Jones Carbon Silicon Steel for Non-corrosive Conditions; Light Loads.**
- **Jones Alloy for Corrosive Conditions; Heavy Loads.**

## SIMPLE RULES TO SAVE SUCKER RODS

1. Loose joints cause pin failures. When running in, make up with ordinary wrenches, then snap with large snap wrenches.
2. Use cleaning fluid freely with wire brush on pin end Threads—use a box washer on box ends.
3. Before stabbing, be sure rod is hanging straight in derrick to prevent cross-threading.
4. Use new pony rods on new strings.
5. Do not hammer couplings.
6. Use thread protectors, after doping, on pin and box ends of all storage racked strings.
7. Do not loosen protectors by pounding. Loosen with wrench—unscrew by hand.
8. Do not remove protectors until rods are hanging in the derrick.



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General Office and Factory, Toledo, Ohio . . . . . Sales Office, McBirney Bldg., Tulsa, Okla.

shown that higher yields of carbon black are possible when operating on liquid with the magnitude of recoveries directly related to the volume of ethane present in the destroyed fuel. Manufacture of carbon black, it is disclosed, required 11 per cent of the nation's total gas consumption in 1942. This potential market for carbon-black manufacture alone has caused numerous engineers and chemists in the natural gasoline and allied cycling industries to carefully scrutinize the required facilities, the cost and availability of recovery equipment and the potential market in other directions.

### Plastic Industry May Beckon

Another possible trend of the natural-gasoline industry in the postwar era is one that would require even more elaborate installations in the plants for the production of additional volumes of materials which could be hydrogenated to olefins. With the added quantities of olefinic materials such as propylene and butylene available from the natural-gasoline operations, it is possible that plant operators will be enticed into the field of supplying raw materials to the plastic and synthetic-fiber industries. One $5,000,000 plant in Texas has been authorized for the production of chemicals from the light hydrocarbons, possibly starting with ethane, or a mixture of that hydrocarbon with propane.

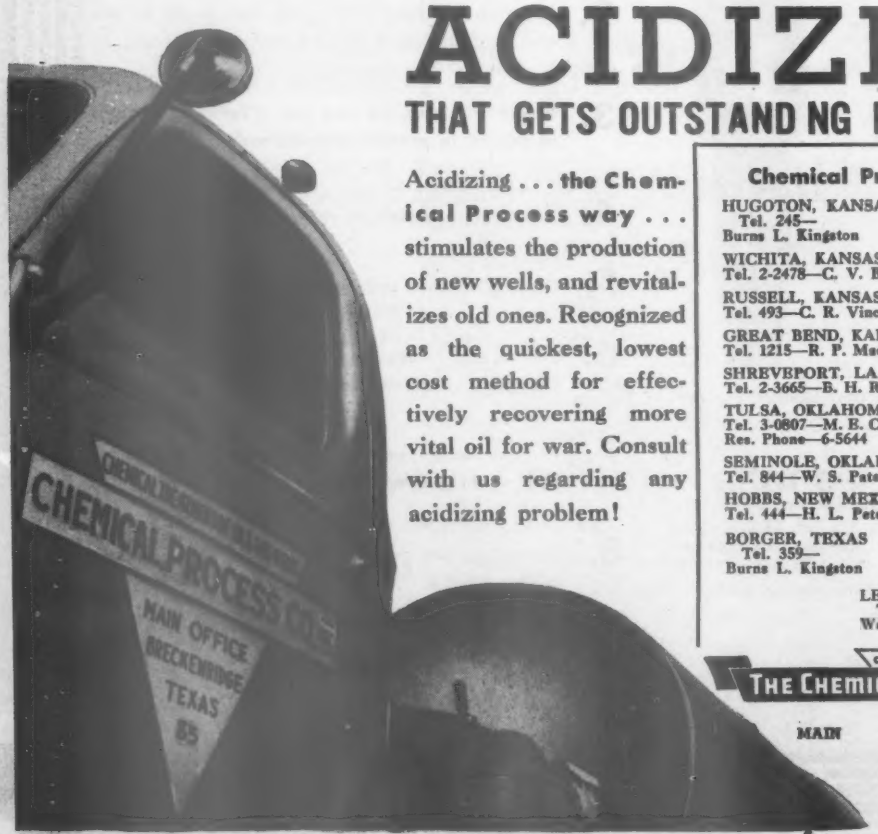
Much of the postwar thought in the natural-gasoline industry is directed at the problem of determining the most economic services for facilities installed as emergency expedients.

### Demand May Shrink

Cost of producing isobutane, for example, has been calculated by several manufacturers at about 11.25 cents per gallon upward, depending on location of the plant with reference to feed stock, condition of facilities and whether the plant was designed especially for this function or adapted to such service under exigencies of war. Plant operators concede that demand for isobutane will shrink from its current high level when requirements for aviation gasoline are reduced at war's end. Numerous plants now splitting their own mixtures of butane and isobutane as well as that of natural-gasoline plants with less modern facilities are enabled to participate in the program only because of government reimbursement for excessive costs. Some authorities estimate that at least 30 per cent of the current field production of isobutane, as distinguished from that made in refineries, would be economically impossible if reimbursement payments, covering added transportation and operating costs were not forthcoming.

### Contributing Factors

Certainly one of the factors contributing to the cost of isobutane is the complex equipment required for the close fractionation between it and butane. Isobutane towers with a minimum number of plates must maintain maximum ratios of reflux. The converse is true, of course, in that the reflux volume can be reduced with the installation of higher towers equipped with a greater number of plates. One plant was built recently with two splitters to handle the normal butane mixture. The manufacturer was faced with the problem of limiting reflux to a ratio of 15:1. In order to use available equipment and to avoid excessive height of the fractionating tower, the engineers designed dual columns to carry out the splitting operation in two phases. Installation of additional towers, however, is not the simple answer to the close fractionating problem that it might appear to be on cursory examination. In fact, the maintenance of efficient balance between the four or five towers which currently constitute the nucleus of a modern natural-gasoline plant is an extremely delicate assignment.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Unit No. A-19

Subject: Squeeze Cementing to Shut Off Wet Zone

Awarded to Los Angeles Plant—1943

Index: 250.1

Date: December 30, 1943

Page: 1

Squeeze cementing affords a safe, economical solution to many present-day well repair and well completion problems.

Thousands of such jobs have been successfully performed with the Baker Model "K" Cement Retainer, which has long been a standard unit of equipment for accomplishing difficult as well as the usual run of squeeze cementing jobs.

Two such typical applications are described and illustrated below.

Today, with conservation of time and materials being of the utmost importance, it is essential that successful results be secured the first time . . . and the Baker Model "K" Cement Retainer has a reputation for obtaining a successful "first-time" job.

If you are not familiar with this device, you can secure complete details from any Baker office or field representative, or see pages 250-263 of the 1942 Baker or Composite Catalog.

*Service Note*
Competent Baker men will advise, make suggestions, and otherwise assist in securing best possible results.

Prod. No. 400
*Baker Model "K" Cement Retainer*

## BAKER MODEL "K" CEMENT RETAINER APPLICATIONS

Recementing • Cementing Behind Sections of Pipe
Reducing Gas/Oil Ratios • Plugging Off Bottom Fluids
Plugging Back to Upper Zones
Testing Upper Cased Formations • Squeeze Jobs
Cementing Off to Perforate for Production
Cementing Bad Pipe • Cementing Two Strings Together
Cementing Low-Pressure Zones
Use of Cement Retainer as Casing Bridge Plug

### JOB NO. 1

**PROBLEM:**

To shut off water entering from bottom of producing zone.

**METHOD:**

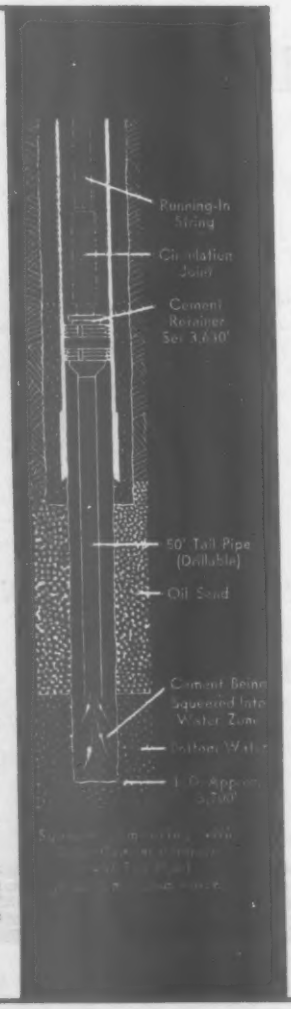
Squeeze cement with Baker Cement Retainer equipped with 50′ (drillable) Tail Pipe.

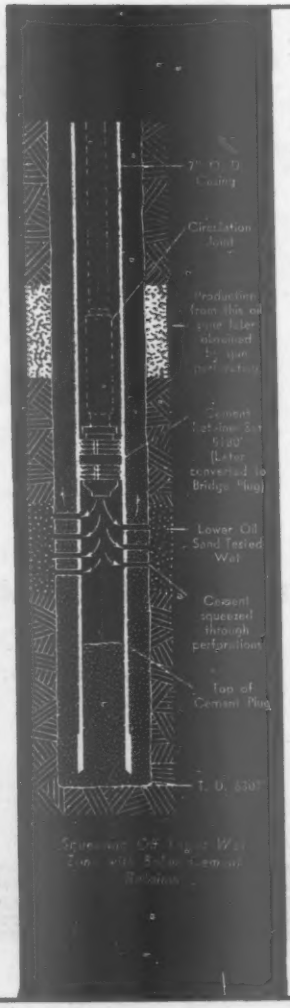
**RESULT:**

Water completely shut off (before performing squeeze, production was cutting 35% water).

**DETAILS:**

Field: Kilgore, Texas
Depth of Well: 3700′
Depth Retainer Set: 3630′
Breakdown Pressure: 500 pounds
Final Pressure: 2100 pounds
Number of Sax Put Away: 534
How Cement Discharged: Through lower end of Tail Pipe into open hole





7" O. D. Casing
Circulation Joint
Production from this oil zone later eliminated by cement squeeze
Cement Retainer Set 5180′ (Later converted to Bridge Plug)
Lower Oil Sand Tested Wet
Cement squeezed through perforations
Top of Cement Plug
T. D. 6307′

### JOB NO. 2

**PROBLEM:**

To squeeze off lower wet sand and protect upper oil zone.

**METHOD:**

Perform squeeze cement job with Baker Cement Retainer and then convert Retainer to Casing Bridge Plug.

**RESULT:**

Wet zone completely shut off; upper zone produced with no water.

**DETAILS:**

Field: Golden Meadows, La.
Depth of Well: 6307′
Depth Retainer Set: 5180′
Breakdown Pressure: 1400 pounds
Final Pressure: 2500 pounds
Quantity of Cement Mixed: 300 Sax
Number of Sax Put Away: 300
How Cement Discharged: Through Perforations

# Use of Tubing for Drill Stem to Deepen Small-Diameter Hole

*by Harry F. Simons*

**For some types of well deepening or reconditioning work, or for drilling in, it might be more convenient to use the tubing already on the job rather than to move in a special string of drill pipe. The question has been whether the tubing could stand the abuse imposed upon it by that kind of work. This article describes a difficult deepening job in which tubing was used with little damage.**

THERE are two principal reasons for drilling with tubing, the first being the elimination of outside diameter wear on the tool joints and the second the reduction in expense of completing or reconditioning a well by not using a special small-diameter drill string. This latter is especially important when either drilling in or working over a small-diameter hole, such as those equipped with 4½ or 5-in. casing.

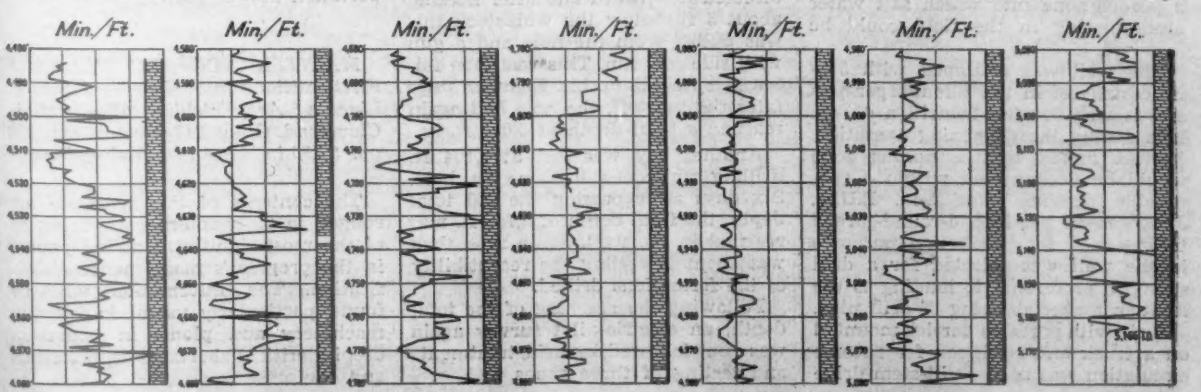
Attempts to substitute tubing or casing for drill pipe when drilling through loosely consolidated formations of the Pacific Coast region have been at least partially successful and were reported in an article in The Oil and Gas Journal[1]. They will not be discussed further here. The use of small-diameter (2 or 2½-in.) tubing for drilling-in and reconditioning purposes has been steadily expanding, particularly since the introduction of reverse circulation. There has been some conjecture as to just how much service such tubing could withstand without being ruined for the purpose for which it was intended, that is, the production string in the well. A recent well in the K.M.A. field of North Central Texas gives a fairly satisfactory answer.

In this well 662 feet of hole was drilled through hard Ellenburger dolomite with a 2-in. string of tubing. In addition there was one fishing job. At the termination of the work, approximately 60 per cent of the tubing was still in condition for use as a production string and some could be used after having the threads repaired. A comparatively few joints had to be discarded and converted into line pipe. There were no joints discarded during the deepening operation due to damage from drilling but 15 joints were laid down when they showed leakage following acidization in which high pressures were used.

Conclusions reached were that small-diameter tubing could withstand more abuse than had previously been thought possible and consequently there need be no fear while using it in ordinary drilling-in or reconditioning operations, that small-diameter tubing makes a poor substitute for drill pipe when everything is considered, and that it is possible to recondition and work in small-diameter holes despite the limitations.

Normally, in drilling-in and reconditioning operations the formations are comparatively soft and unconsolidated or at least poorly cemented. Drilling time in the pay zone is often as little as 1 minute per foot and not very often more than 5 minutes per foot. The accompanying drilling-time curve shows only a very few points where the drilling time was as little as 5 minutes per foot. Gen-

*Drilling-time curve and log of well in K.M.A. pool deepened from 4,484 ft. to 5,166 ft. with 2-in. tubing and reverse circulation*



erally it was considered more than 10 minutes per foot and quite often more than 15 minutes per foot. The average cutting rate was 14.3 minutes per foot.

Total time actually spent in drilling (162.5 hours) is approximately 28¾ hours more than the average time required to drill a group of 3,000-ft. wells in Illinois from below surface pipe to casing seat[2]. There was no odometer on the rig used on the K.M.A. well but the average speed maintained on the rotary table was around 100 r.p.m at which rate the total revolutions would be only slightly under that of the average total revolutions from surface pipe to casing seat in the Illinois wells mentioned above. Total calculated number of revolutions on the K.M.A. well was 972,000 while the recorded average on the Illinois wells was 989,460 revolutions.

### Only Three Shale Breaks

The log of the well is shown along with the drilling-time curve and in the 682 ft. of drilling there were only three shale breaks totaling 5 ft. The remainder was all dolomite of varying hardness but mainly quite hard. The dolomite was cherty and the drilling rather rough. There was a tendency for the bit to hang up part of this time and this caused some excessive makeup of the joints.

Weight applied to the bit was approximately 6,000 lb. throughout the drilling of the hole. This is equivalent to the weight of almost 1,300 ft. of the tubing. Roughly, this amount of weight compares to 19,000 lb. on an 8¼-in. bit, which is about as much as is normally run on that size.

The fishing job did not add greatly to the wear and tear placed on the drill pipe except for the trips and for the high pressure used in acidizing. This caused collar leaks which removed the lubrication and permitted the threads to gall when the joints were broken out. This necessitated laying down 15 of the joints and the replacement of the collars.

The purpose of the job was the deepening of a producing well nearing exhaustion in the hope of finding a porous zone into which salt water accumulating in the field could be disposed.

The well was equipped with 5½-in. casing set in the Ellenburger pay and it was decided to drill a 4¾-in. hole during the deepening operation. It was hoped that a porous zone would be encountered within a reasonable distance. The 2-in. E.U.E., J-55, 4.70-lb. per-foot, 8-round-thread tubing used for production purposes in the well was selected for a drill string in preference to hauling to the location a special string of drill pipe.

A rig with portable derrick mounted on a truck and equipped for reverse circulation was used. Drill-stem drive was through a differential-type pack-off head. Pump for handling the drilling fluid was 5-in. by 8 in. and it was operated at approximately 50 s.p.m. Salt water was used for a circulating fluid and all of the hole drilled during the job was by the reverse circulating method. (Note: This is not the greatest amount of hole drilled with reverse circulation as an experimental project several years ago drilled more than 1,000 ft. of hole in that manner).

The tubing was handled exactly like drill pipe. While coming out of the hole, the joints were broken with the tongs and then spun out. The joints were spun up and then tonged tight while going in the hole.

After making 554 ft. with no outstanding difficulty and while the thirteenth bit was on bottom, a twist-off occurred and one joint of tubing and the bit were left in the hole. Total depth at the time was 5,038 ft. and it had taken 10 days to reach that point from the old total depth. An overshot failed to catch the fish and a 3-in. wash-over string of three joints parted at the bottom joint but was recovered with a tapered tap. The fish was caught with a 2-in. tap hung up 75 ft. off bottom and pulled loose. After catching the fish a second time, an attempt was made to acidize it free but this failed. A tubing spear likewise did not recover the fish.

### Receptibility Tests Made

Receptibility tests of the formation drilled through previously then were made to see if the well might possibly already be satisfactory for disposal purposes. Tests were made with and without a packer, the latter being set after a hole-caliper survey. An electric pilot then was run to check the permeability of the stratum.

A 3-in. whipstock was run in the hole and cemented with 25 sacks at 4,942 ft. Cement was then drilled out to the whipstock with a 3⅞-in. bit and this hole reamed to 4¾ in. Instead of attempting to drill off of the face of the whipstock, the hole was sidetracked by using an acid jet gun. The first gun run had its jets directed downward and after making about 3 ft. below the whipstock this was pulled from the hole and a gun with side jets run. This was then followed by a 3⅞-in. bit. Eighteen days after the twistoff, the hole had again reached a total depth of 5,038 ft.

Another day was lost at 5,104 ft. drilling up cones lost in the hole. Six days after passing the old total depth, the final depth of 5,166 ft. was reached in the well. Some time then was spent in testing the receptibility of the formations drilled.

Following the reaching of the total depth, an electric-pilot survey again was run, followed by acid treatments and testing of three zones.

While the hole was not surveyed for vertical deviation it was known to be crooked because of the action of the drill stem and because of the difficulty in getting tools the same diameter as the hole through it. Drill pipe, while flexible, has a greater wall thickness and more rigidity and would reduce the tendency of the hole to wander. Drill pipe is also not as easily broken as tubing and generally is more satisfactory for drilling purposes.

Deepening of the small-diameter hole is in itself a feat worthy of some note because this consideration has been much discussed during slim-hole arguments. It is apparent that by using a small-diameter drill stem it is possible to deepen many of the slim holes at least 1,000 ft. through favorable formations without too much difficulty if the occasion arises. Slightly different technique may be required during this drilling. Small-diameter liners and possibly smaller than 2-in. E.U.E. tubing will then be needed for equipping such holes.

### Bibliography

1. Shell Drills 8,200-Ft. Wells With Tubing, by L. P. Stockman, The Oil and Gas Journal, Jan. 9, 1941, p. 32.
2. Report of Eastern District A.P.I. Topical Committee on Drilling Practices, A.P.I. Production Bulletin No. 224, p. 84.

# BOOK REVIEWS

*WAR WORKER TRANSPORTATION. By Theodore M. Matson, director, Bureau for Street Traffic Research, Yale University. Published by Institute of Traffic Engineers. 146 pp.*

This report deals with every phase of the problem as it has developed in actual experiences at existing war plants. It is packed with clear, logical discussion and evaluation of such items as staggered hours, group riding, access roads, parking and terminal arrangements. The study should be of real value to those charged with the problem of personnel transportation at war plants.

*MAINTENANCE ARC WELDING. First Edition. Published by James F. Lincoln Arc Welding Foundation, Cleveland, Ohio. 242 illustrations. 233 pp. $0.50 in U.S.A., $0.75 elsewhere.*

The contents of this book are arranged in 25 chapters, comprising 25 of the most significant award papers in the program's maintenance classification. The information will be found particularly useful in keeping machinery and plants in operation despite critical shortages in materials and equipment.

# SAFETY FOR Cracking Plant Equipment

*Information supplied by the "Oil and Gas Journal"*

There are two sides to safeguarding equipment and operations in cracking plants. One is the means taken to prevent accidents. The other is the methods adopted to minimize damage from such accidents as do occur.

The former comprises the usual safeguards for ladders, stairways, catwalks, etc., and cleanliness around equipment. It is also suggested that caliper inspection of tubes be frequent and thorough, especially of the first 24 inches. Cleaner rotors should not be allowed to idle in the tubes. De Florez cone-bottomed safety drills should be used at frequent intervals in pipe subject to corrosion.

The primary precaution in the matter of limiting damage due to accidents is the provision for shutting down equipment instantaneously in case of trouble.

Equipment should be provided with remote controls actuated from a protected or safe location. For example, hot oil pumps, either steam or electrically driven can be shut down by a valve, or switch located outside the pumphouse.

Shutting down furnace burners can be accomplished by quick acting emergency valves in the oil or gas supply lines. These valves should be located in accessible, but safe, places.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## ★ INCREASED EFFICIENCY WITH USE

A limited amount of dust clings to the outside of the filter medium during use. This amount is limited by vibration transmitted from the engine, which shakes off most of the dust. The remainder acts as a filter, *increasing* efficiency with use instead of decreasing it, as in liquid-type filters.

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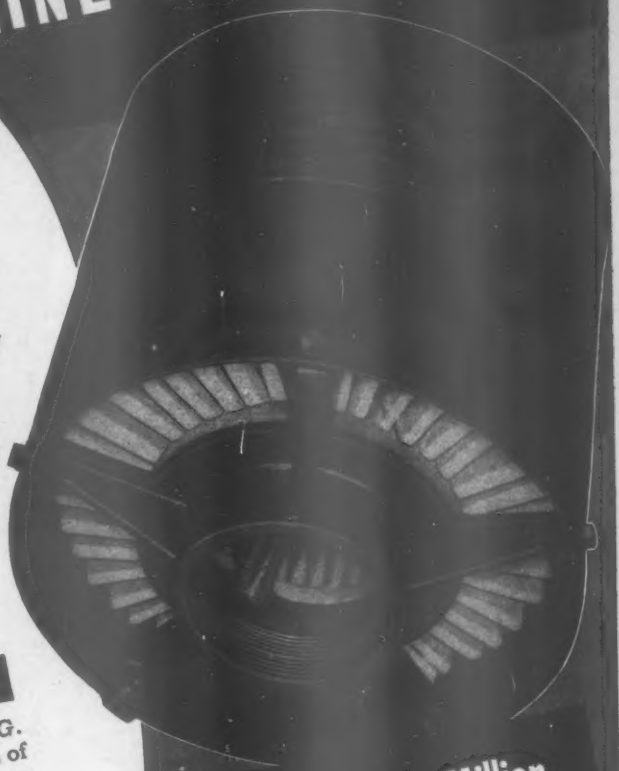

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# Well-Point Drainage At Northern Natural River Crossing

*by Paul Reed*

*Completing ditch with ditching machine after the upper part of the ditch has been excavated by drag line. Upper sides of ditch are trimmed with slopers*

TO insure that main-transmission-line operation will not be interrupted by future floods in the Arkansas River, Northern Natural Gas Co. is laying a 24-in. loop parallel to the 26-in. main transmission line. Location of the river crossing is about a mile south of Ellinwood, Kans. The entire loop consists of 24 miles of pipe of which 13,000 ft. is at the river crossing. Normal width of the channel is about 300 ft.

There has been some trouble in the past due to damage when pipe of the 26-in. main line has been washed out at approach to the bridge which supports it over the river.

In laying 24-in. pipe for the new river crossing, measures have been taken to avoid injury from the scouring conditions of flood time by placing the line at a depth of 8 ft. below the river bed.

The entire undertaking of building the loop and the river crossing is being handled by J. C. Truman Construction Co. Work started October 15.

A bulkhead was built to divert the current from 65 per cent of the channel during the first part of operations in order to facilitate laying of pipe in the river bed. After pipe had been laid as far as this diversion permitted, the same bulkhead arrangement was used to turn the current to the other side so that laying of pipe could be completed across the remainder of the channel.

Overburden of sand in the river bed was removed with bulldozers for a width of 60 ft. so as to reduce by 8 to 12 ft. the distance that water would be raised by the pumps.

For dewatering the ditch 800 sand or well points were set. Water comes through three 8-in. lines, serving as suction barrels, to the pumps. Along the suction barrels, well-point connections are at 24-in. intervals. By use of six 10-in. by 8-in. centrifugal pumps discharging into six 8-in. discharge lines, underflow from the sand has been pulled so that pipe could be laid in a completely dry ditch.

The ditch in the river bed has been dug with drag lines to the desired depth, below the excavation made previously by bulldozers. At approaches to the river crossing where the ground is sandy, the upper part of the ditch has been dug by drag line and the lower part by ditching machine equipped with slopers, fabricated for trimming the upper part of the ditch walls. A drag towed behind the ditcher insures having the bottom of the ditch in the desired condition. In addition to ditching equipment the principal units have been two D8 tractors, three drag lines and the electric welding equipment.

Pipe has been cold bent by a CRC bending jig which is said to have saved two-thirds of the expense and three-quarters of the time usually taken. In 1 day 71 bends were made in 9 hours. To have done this with fire bending, three crews would have been required.

Welding has been done with 5/32 and $\frac{3}{16}$-in. rods, four beads being applied for welding pipe joints and eight beads for each sleeve weld.

On either side of the river channel, 6,000-lb. concrete anchors fabricated prior to installation, are installed at 40-ft. intervals. When in place pipe is clamped to these concrete blocks serving as anchors in the area subject to inundation in flood periods. In the river channel itself, the line is equipped with 6,000-lb. cast-iron river clamps at 40-ft. intervals.

*Drag line excavating ditch in which pipe is lowered. Three suction barrels are used in connection with dewatering operations*

# Oil-Well Pumping Practices—No. 23

# Calculation of a Unit Pumping Installation

*by J. Zaba*

THE starting point of design of a sucker-rod unit pumping installation is production to be handled and the depth from which this production is to be lifted. This information on a well, which ceased to flow and is about to be "put on pump," can be secured in one of several possible ways. The number of barrels of fluid which the well is capable, or is permitted, to produce and the corresponding fluid levels may be determined from the history of the well itself. Data on adjoining wells, already on mechanical lift, may be used. Bottom-hole-pressure survey or fluid-level survey data may be applied. Tests with temporary pumping unit may be made before permanent installation is designed. This last method is of course the most satisfactory one since it furnishes direct information on loads resulting from different combinations of composite elements of the pumping cycle.

Assuming that no temporary unit is available and that the design of the installation has to be made on basis of information on expected production and lift, calculation of the equipment to be used may be carried through in several possible ways. Regardless of the method used, certain initial assumptions have to be made. It should be remembered that even within the limits of sizes of plunger, lengths of stroke and speed of operation as used in oil-field practice, there exists a practically unlimited number of possible combinations of these three component factors, and that certain of these combinations will produce the desired quantities of fluid with lesser loadings to the equipment than others. In order to arrive at the best possible combinations, sizes of certain elements have to be assumed and from these assumptions, the sizes of other elements have to be calculated. While there are several possible methods of approach, the general outline of procedure would be as follows:

For given production and lift assume several possible sizes of plungers and corresponding sizes of rods. Calculate, for different combinations of stroke and speed of operations, the actual plunger travels and displacements. For displacements which correspond to the expected production calculate the polished-rod loads and torques for assumed counterbalance. Selection of combination which gives, for given production, most satisfactory loads and torques determines the sizes of subsurface equipment and the structural parts and reducer of the surface equipment. For selected combination determine the power requirements to arrive at the size of the prime mover.

### Pumping Calculation Methods

Formulas and methods needed for calculation of pumping installation were presented in the preceding installments of this series in arrangement which was needed for logical sequence of discussion of a sucker-rod unit pumping installation. This is not necessarily the sequence in which they would be used in calculations of actual design. Furthermore, depending on the manner of approach of the problem, different formulas may have to be used. To illustrate this and facilitate practical use of the formulas, some of the possible methods of calculations will be summarized, together with reference to the installment in which the needed formulas have been presented.

One of the possible methods of calculation would be as follows':

1. With given expected production and lift assume certain stroke and size of rods to be used.

2. Using Coberly's formula for plunger size for maximum production (Installment 11) determine the diameter of the plunger.

3. Using the correction factor (Installment 11) determine the plunger size for the given stroke at different speeds of operation.

4. Repeat the procedure for two or three different lengths of stroke.

5. If the tapered-rods string is decided upon, select the amount of each size of rods on basis of manufacturer's recommendation. (Installment 8).

6. Determine actual plunger travel for different combinations of speed and stroke using any of the plunger travel formulas. (Installment 9).

7. Determine the displacement for different combinations of speed and stroke, using calculated plunger travel and assuming certain volumetric efficiency. (Installment 11).

8. For displacements which correspond to the expected production determine the peak polished-rod loads. (Installment 7).

9. If desired, check the loads against the allowable stresses of the already selected sucker rods. (Installments 7 and 8).

10. From the calculated peak polished-rod load and assumed counterbalance (Installments 14 and 21) determine the peak torque. (Installment 21).

11. Determine the allowable well load from peak torque for different strokes and assumed counterbalance. (Installments 16 and 21).

12. Select combinations of speed and stroke which furnish the required production under most favorable conditions of load and torque, thus arriving at the necessary size of the structural parts of the surface equipment and the reducer. (Installment 21).

13. Determine the power requirements of the installation. (Installment 17).

14. Select the necessary prime mover. (Installment 22).

A variation of this method would be to start with several arbitrarily selected plunger sizes and to work out the displacement and loads for

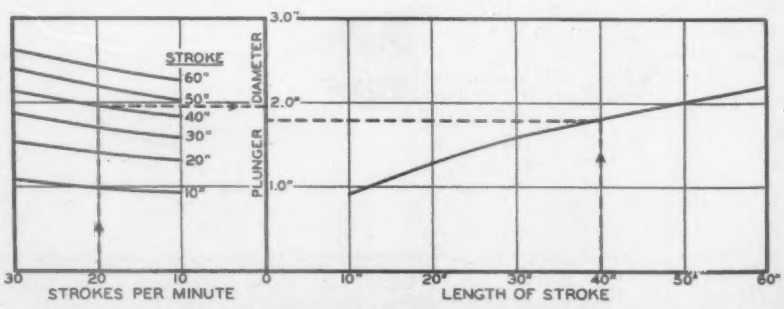


*Fig. 1: Chart for plunger diameter for maximum production, ¾-in. rods, 4,500-ft. pumping depth, specific gravity of 1, tubing anchored near pump*

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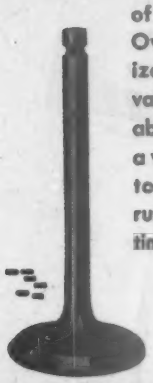

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each of these sizes and certain selected sizes of rods, lengths of strokes and speeds of operation as given in the general outline of procedure.

Relation between required torque and expected production and lift can be established directly by using as starting point the formula for plunger diameter resulting in minimum load for given production (Installment 11). Substitutions are then made in Slonegerʼs formula for peak polished-rod load (Installment 7) in such a manner that the load is expressed as function of production, lift and weight per foot of the selected sucker-rod string. The net well load and torque can then be expressed in the same terms. For selected stroke the torque can be calculated.[2]

Still other methods of approach may be used. The main point is that the installation has to be worked as a unit and the subsurface equipment has to be calculated not only from the standpoint of displacement but also from the standpoint of loads and torques. The starting assumptions will depend of course on the personal preference of the purchaser. That means that the size of the installation will depend on how close the purchaser wants to come to the safety margin in the interest of the economy of the initial investment. Another controlling factor will be whether or not the installation is calculated for the whole pumping life of the well.

Before working out an actual example, it is necessary first to make a few remarks in regard to methods of calculation outlined above.

First, it would appear that the above methods involve considerable work and calculation. This is of course true. However, for given combinations of plungers, rods, strokes and speeds of operation, even more complicated formulas reduce themselves to very simple equations. Furthermore, if one of the combinations is assumed and others are being worked out, certain terms repeat themselves and do not have to be calculated each time. Of great help in such calculations is construction of charts for a given set of conditions. These charts do not have to be elaborately worked out and finished but they do have to be of sufficiently large scale to be readable and, of course, they have to be accurate. To illustrate the above points, assume a well with pumping depth of 4,500 ft. and expected production of 300 bbls. per day. Fluid of specific gravity of one is assumed, it is planned to anchor the tubing close to the pump and ¾-in. rods have been selected. Suppose that it is planned to determine the plunger size for maximum production using Coberly's formula. For the above given and assumed conditions of this specific case the formula would be:

$$\text{Plunger area} = \frac{\text{pol. rod stroke} \times \text{modulus of elasticity} \times \text{rod area}}{10.39 \times \text{sp. gravity} \times (\text{pumping depth})^2}$$

$$= \frac{\text{pol. rod stroke} \times 3 \times 10^7 \times .442}{10.39 \times 1 \times (4500)^2} = 0.063 \times \text{pol. rod stroke}$$

In other words, for combination of ¾-in. rods, 4,500-ft. pumping depth and specific gravity of 1 the formula becomes a simple expression:

$$A = 0.063 \times S \qquad (1)$$

where

A = plunger area for maximum production, sq. in.
S = polished rod stroke, in.

Suppose further that correction factor for number of speeds of operation is to be worked. For the above given assumption the formula would be:

$$\text{Correction factor} = 1 + \frac{2.4\left(\frac{\text{length of rods}}{1000} \times \text{S.P.M.}\right)^2}{100{,}000}$$

$$= 1 + \frac{2.4 \times (4.5 \times \text{S.P.M.})^2}{100{,}000}$$

$$= 1 + 0.00048 \times \text{S.P.M.}^2$$

Again, therefore, for the given conditions, the original formula becomes a simple equation:

$$F = 1 + 0.00048\,N^2 \qquad (2)$$

where

F = Correction factor for overtravel
N = Number strokes per minute.

Calculations with these two formulas, even for considerable number of strokes and speeds of operation, do not result in too excessive work.

In regard to charts which can be prepared to facilitate calculations, many possible forms of charts will suggest themselves, depending on preference of one making the calculations. To illustrate a simple chart, shown in Fig. 1, has been prepared

for the above given two formulas. On the right-hand side of the chart diameters of plunger for maximum production are given for different lengths of stroke. Formula 1 was used, after areas were expressed in corresponding diameters. Curves on the left-hand side of the chart represent values corrected for different speeds of operation. For instance, for 40-in. stroke the diameter of plunger for maximum production can be read on vertical scale as being 1.8 in. For 20 s.p.m. speed of operation and for 40-in. stroke this diameter becomes 1.95 in. It should be emphasized again that this chart is valid only for conditions stated. It should be mentioned here also that the formulas are for static loads and downward adjustment of plunger diameter should be made in case of higher speeds.

### Special Pumping Conditions

The second point which should be brought out in connection with outline of different methods of calculation given above is that they apply to average conditions only. In cases where special conditions prevail, such as, for instance, considerable deviation from the vertical of the well bore, due weight should be given to these conditions.

The third point is that even for average conditions these calculations represent only an estimate. This fact has been emphasized throughout the series. The formulas used are after all nothing else but conclusions, set up in mathematical form, from certain theoretical investigations supported by experimental or field data. As such, they cannot be considered as definitely correct for given set of conditions. The calculations if properly carried through will give data representing reasonably safe values. For the sake of efficiency of operation, however, a calculated installation, once in operation, should be tested for loads, production and power consumption at different operational conditions. A convenient method of graphic analysis of such tests is to plot production, measured loads and measured power requirements on one chart against different combinations of speed and length of stroke. The most favorable pumping conditions are quite apparent in such a presentation[4].

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1. This method is followed, partially, in calculating a pumping installation on p. j-20 of the "Producing Equipment Directory," 1940-41.

2. D. O. Johnson: "Analysis of Optimum Sucker Rod Pumping." A paper presented before Dallas, Tex., spring meeting of the petroleum division of A.I.M.E., May 1943.

3. Emory N. Kemler: "Economic Selection of Oil-Field Equipment." Oil Weekly, June 30, 1941, p. 28.

4. Frank Briggs: "Oil Well Pumping—The Importance of Plunger Travel." International Oil, October 1941, p. 31.

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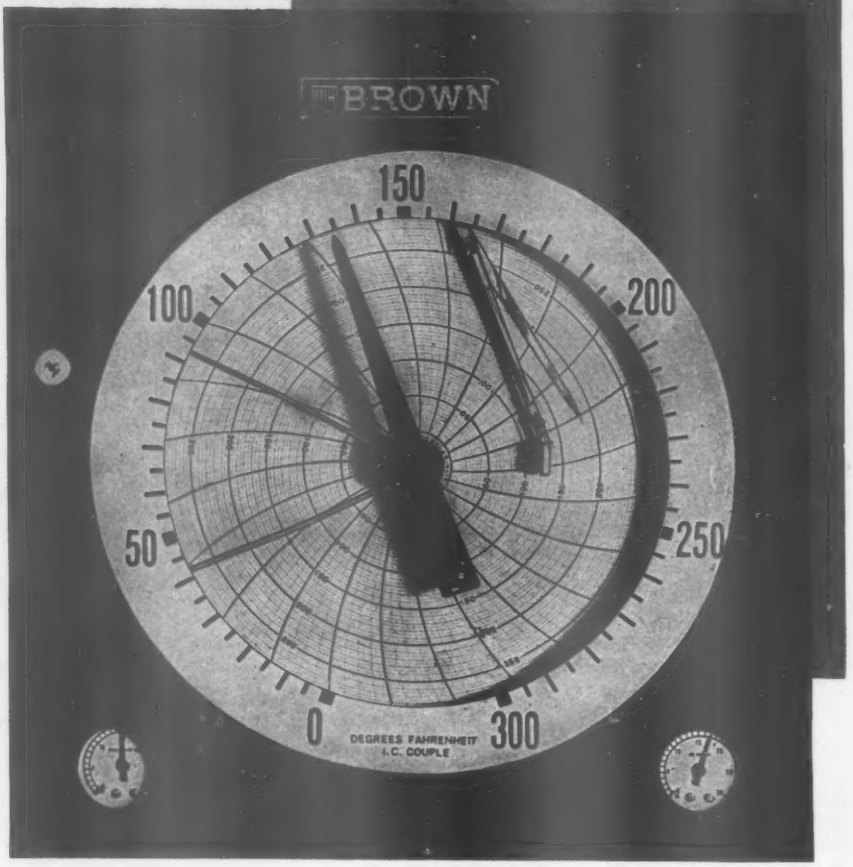


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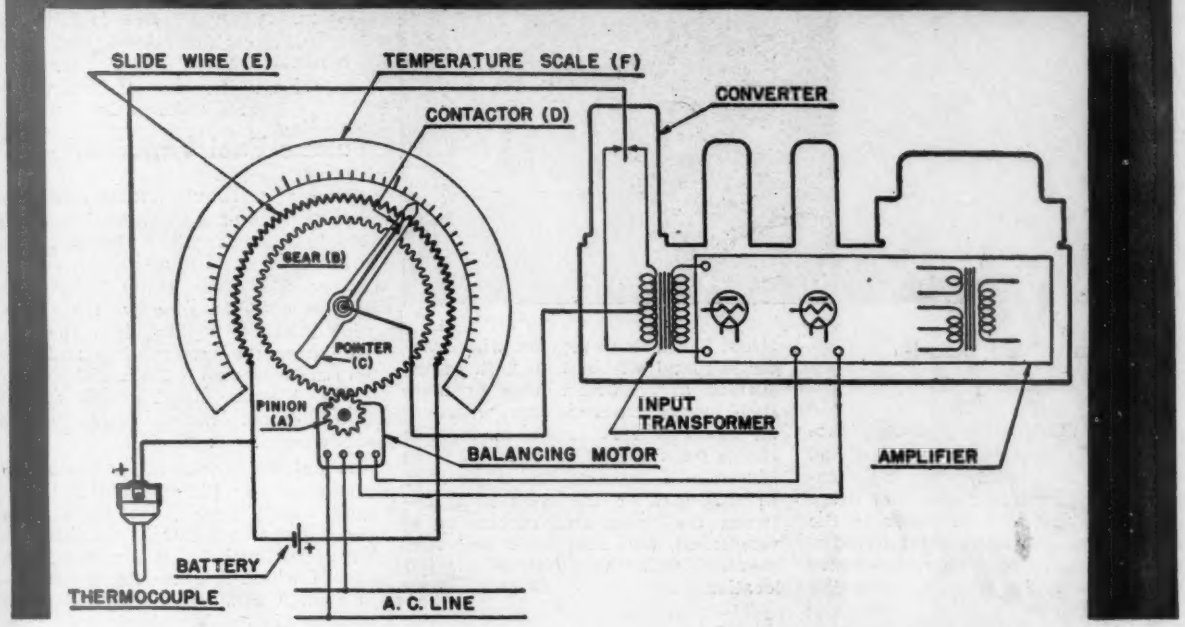


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# PLANT PRACTICES

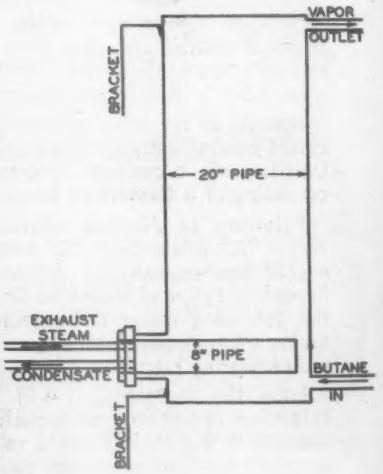
## Steam Jacket for Water Draw-Off Line Prevents Freezing

FREEZING of water drawn off from the bottoms of columns is a winter hazard in gasoline plants and refineries located in cold climates. It often is necessary to provide some means of heating the water stream as it leaves the column. Operators of a Kansas gasoline plant have devised a steam-heated half shoe jacket which fits over the water outlet line at the base of the column. It is made from two pieces of half pipe, one having slightly smaller diameter than the other. These are put together, one inside the other with a thin spacing between them for steam and with ends and edges sealed. Two ½-in. nipples are welded in openings cut through the top piece, one on each side, for steam inlet and outlet connections. Steam passing through inner spacing is obtained through a ½-in. pipe from a nearby, overhead live steam line and is returned to the condensate recovery system. A small valve is fitted in the inlet line to cut off the steam when not needed.

### Butane Fuel Vaporizer

IN order to supply butane as fuel to a series of gas engines totaling 500 hp. the vaporizer shown in the drawing was built at a Midwest refinery. The main drum is an 8-ft. section of 20-in. pipe with a 1½-in. pipe inlet by welding into the side wall near the bottom. Top and bottom are closed with 20-in. disks welded in. A vapor outlet line is welded into the top, leading butane vapors to the engine manifolds.

About 18 in. above the bottom a section of 8-in. pipe is inletted to extend nearly across the 20-in. pipe body. Exhaust steam is admitted to the upper level of this 8-in. pipe, each end of which is closed by a welded-in disk. A small pipe inserted in the bottom of the 8-in. horizontal pipe allows exit to condensate from the exhaust steam which is admitted as




vaporizing means. Liquid butane is admitted to the bottom of this vaporizer, rises until it reaches the steam-heated 8-in. pipe and is vaporized. The rate of vaporization is determined both by the manifold "pull" from the engines on that vapor space in the vaporizer, and by the rate at which butane is admitted. When the butane level is allowed to fall below the heater pipe vaporization rate is reduced or practically stopped, and to increase vaporization butane is admitted at a higher rate.

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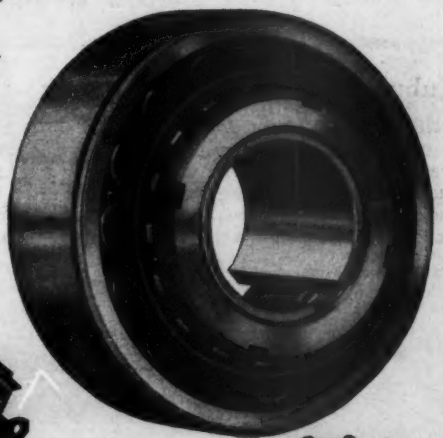

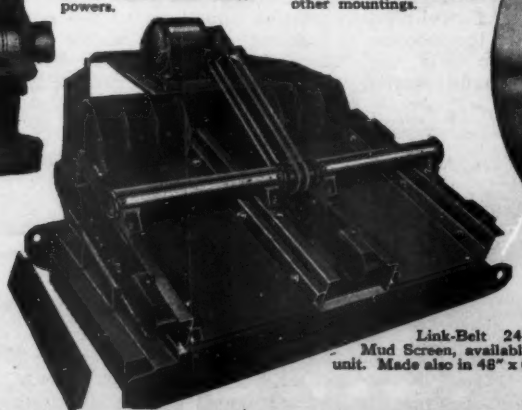

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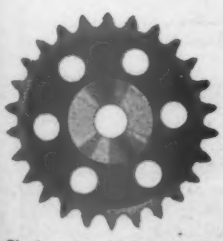

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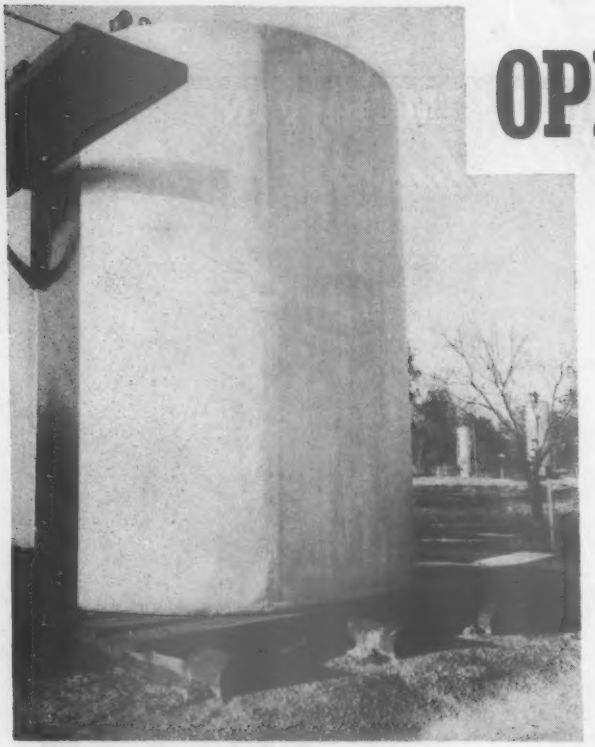


## Plank and Pipe Tank Foundation

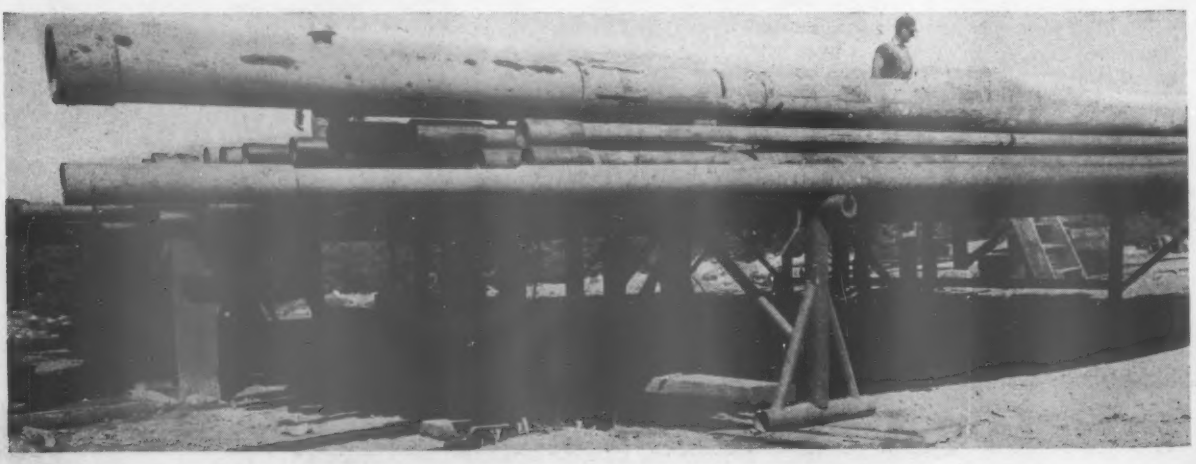
ONE of the best protections against corrosion for tank bottoms is to keep them dry, and in turn this is best done by keeping them off the ground, which contains both moisture and electrolytic salts. There are a number of ways of doing this but one operator uses a foundation made of old tubular material of large diameter and planks. Three pipe stringers, set in small batches of concrete to hold them in position, run the entire length of the battery. Heavy planks are laid across the stringers as flooring for the tanks. Ends of the pipe are blocked to prevent collection of refuse in them.

## Mud Mixer for One-Pump Rig

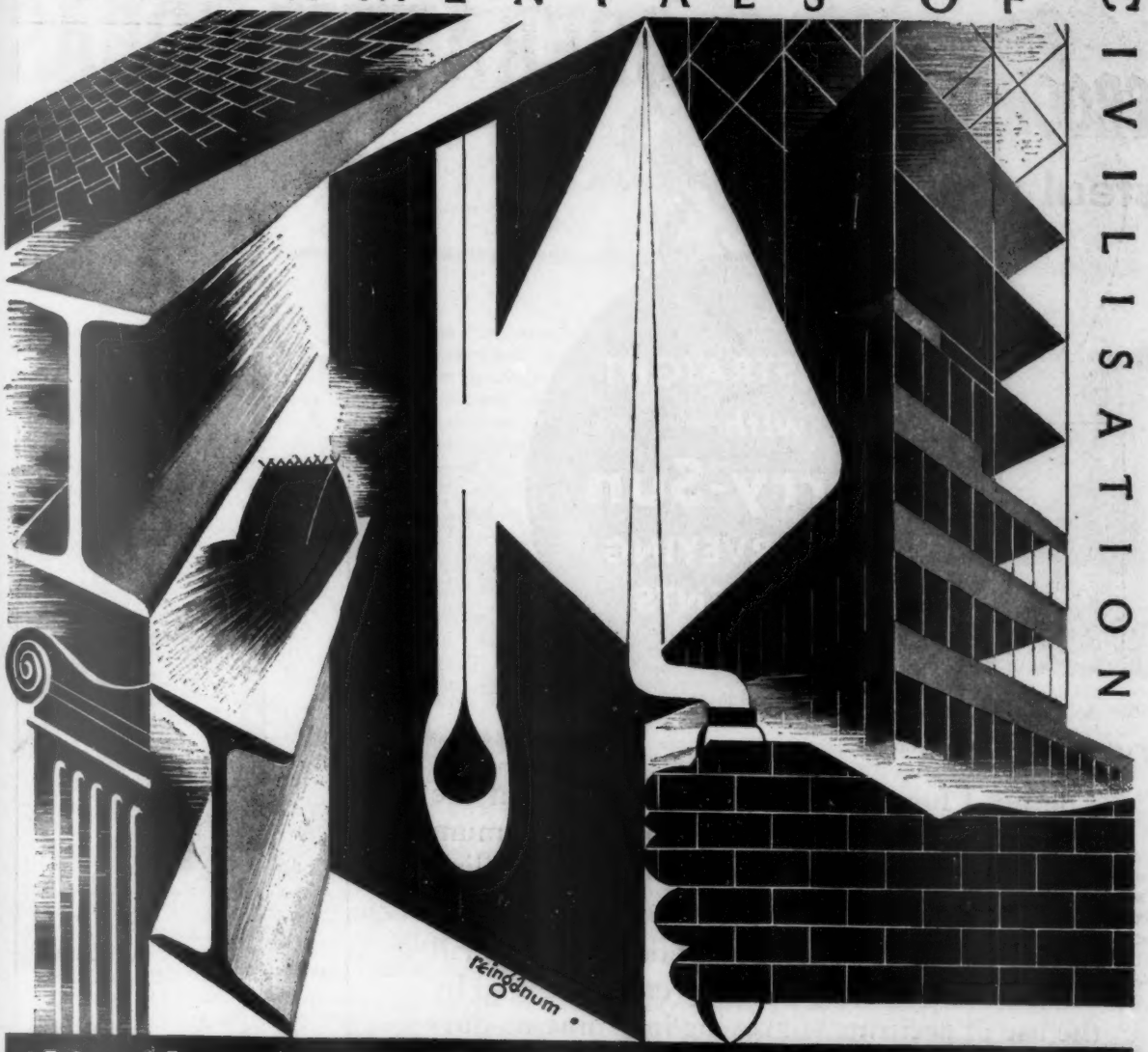
MUD mixing continues to be a problem on mechanically driven rotary rigs which have only one pump, since there are many times when it is not desirable to stop regular circulation long enough for that purpose. In the arrangement shown in the picture, jet action of a small stream of mud at high pressure taken from the pump bleeder line is employed. It sucks mud admixtures through a 2-in. hose into the fluid stream emptying into a drum, the bottom end of which is connected to the pump suction.

## Tubular "Horses" for Pipe Rack

INSTEAD of using wooden pipe racks which usually are tailor made at each location, many drilling contractors and operators have gone to the use of steel pipe racks. The first of these were designed after the wooden racks with crossbraces connecting the two sills but experience has shown that this bracing is unnecessary and an adequate rack can be built with two individual trestles of tubular material. The trestles are built with an adequate foundation which allows them to stand with no bracing. Once the pipe is loaded on the rack, the trestles cannot be turned over. This eliminates bolting together, etc., and makes the moving of the structure much easier. Discarded drill pipe is used for making the trestles.



# FUNDAMENTALS OF CIVILISATION




## No. 4 SHELTER

To possess a habitation is the common instinct of every living creature. Nature displays many marvels of ingenuity and constructive skill only surpassed by man. But the spider still spins its web as it did millions of years ago. Aeons of change and development in living organisms have added nothing to the materials of construction used by the birds, beasts, fishes and insects.

The highest product of evolution is man, who acquired reasoning powers which first enabled him to abandon the clammy caves for the warmth and comparative security of a wood and wattle hut. From these dim beginnings he learnt to make bricks from clay; to hew and carve the stone for temple and cottage. Yet, though he acquired skill to fashion rich architectural gems with greater spans of roof in wood and stone, his shelter was still earthbound.

With the advent of steel his imagination began to soar till now it has become essential to his needs in erecting structures of towering height. The progressive genius of man will find even greater scope in utilising the many forms of steel in the light, airy and spacious edifices for the cities of the future.

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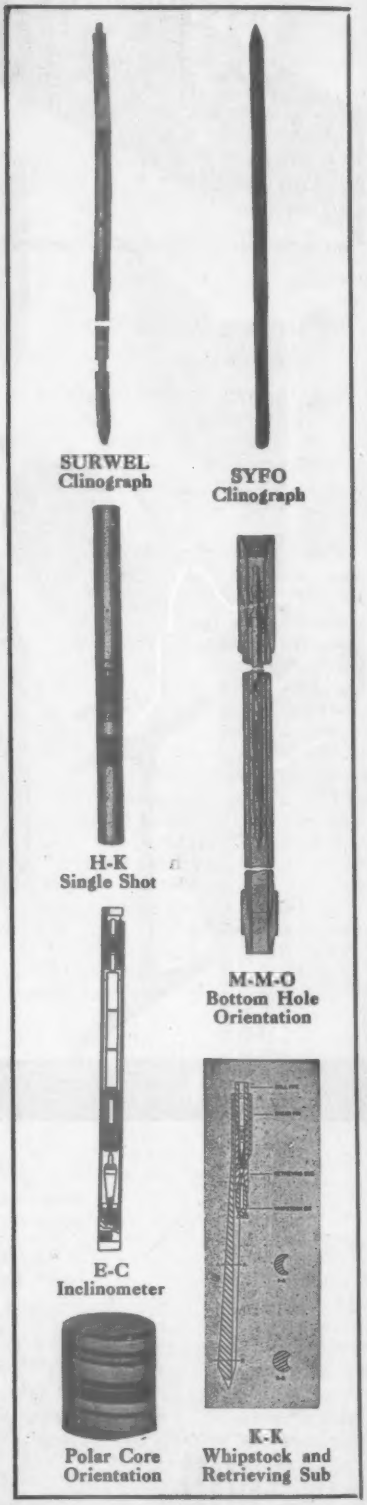


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# QUESTIONS on TECHNOLOGY

*by W. L. Nelson*

**This department was created for the purpose of aiding managers, superintendents, engineers, chemists and all those engaged in the various phases of plant operation; also those connected with the marketing and utilization of petroleum products. Readers are invited to submit their problems to W. L. Nelson, technical editor. Questions should be submitted in as much detail as possible. Inquiries must be signed, but only the given initials will be printed. The source of the question is considered to be confidential. Questions requiring a discussion of patents, extended computations, or a detailed study cannot be considered. When the matter is of general interest, a reply will be published within a reasonable time.**

## Research on Exchanger Transfer Rates

**Can you tell us if you know of any current or recently completed research on heat-transfer rates in shell-and-tube heat exchangers, from liquids to the outside of tubes in cross flow?—R. M. A.**

Although much research on somewhat theoretical aspects of heat transfer has been conducted, there is scarcely any published information on heat transfer in complicated equipment, such as commercial exchangers. Such work has been discouraged by the impossibility of foreseeing the magnitude of the fouling factors or dirtiness that are always encountered in commercial equipment. The dirtying of the heat-transfer surface has the net result of erasing, to a large extent, many of the variables which students of heat transfer have learned to consider as important. Thus, the effect of specific gravity, thermal conductivity and specific heat of the fluid become almost negligible, and even viscosity and velocity lose much of their importance. Fouling factors for petroleum equipment have been discussed in any completeness in only three references, i.e., Petroleum Refinery Engineering, 2nd Ed. pages 406-412, McGraw-Hill Book Co., Inc., New York; Standards, Tubular Exchanger Section of Tubular Manufacturers Association, 366 Madison Avenue, New York; and Nelson, Refiner & Natural Gasoline Manufacturer, August 1934. Information on other industries is even scarcer. Fouling is so vital in exchanger design that no amount of effort in obtaining good transfer rate data will be of any avail if adequate data on fouling are not available.

Studies of the heat-transfer rates of liquids flowing through the tube bundles have been made by:

Short and Stack, The Oil and Gas Journal, May 10, 1934, Page 115.

Perrone, S. A., The Oil and Gas Journal, March 28, 1935, Page 71.

Kallam, F. L., seet Pet. Ref. Eng., 2nd Ed., Page 402.

Nelson, W. L., The Oil and Gas Journal, January 19, 1939, Page 40.

Nelson, W. L., Fluid Volume in Exchangers, The Oil and Gas Journal, March 13, 1941, Page 57.

Nelson, W. L., Plant Exchanger Transfer Rates, The Oil and Gas Journal, July 4, 1910, Page 321.

McAdams, W. H., Heat Transmission, McGraw-Hill Book Co., New York.

It must be stated that these sources do not entirely answer the question, and that wide experience is necessary in designing exchanger equipment.

## Containers for Gaseous Aircraft Fuels

**I recall reading of the use of liquid natural gas as a fuel for aircraft engines. The conclusion was that suitable materials for containers were not readily available. Possibly you can suggest to me the name of the article.—H. S.**

The use of gaseous fuels, even when liquefied by pressure, requires the use of pressures somewhat as follows:

| | Lb. per sq. in. |
|---|---|
| Methane | 1,500 |
| Ethane | 900 |
| Propane | 200 |
| Butanes | 65 |
| Natural gas | 1,200 |

The reason for the use of such pressures is to be able to put a reasonable amount of the fuel (in pounds) into the gas tank or cylinder. When using even the high pressures indicated above, the actual pounds and heating value contained in the gas tank will be considerably less than pounds of gasoline that can be held in a tank of the same size.

Obviously, gas cylinders can be built to withstand the pressures that are required, but they would be extremely heavy. Perhaps you may wish to examine the article entitled, "Compressed Methane Fuel," which appeared on page 44 of The Oil and Gas Journal of August 7, 1942, and one entitled, "Compressed Gas Not a War Substitute for Gasoline," on page 47 of The Oil and Gas Journal of December 17, 1942.

## Oil Shale Pilot Plants

**When and where are the three rather large pilot plants for oil shale that are discussed in the newspapers? —A.H.L.**

The study of oil shale distillation in pilot plants, by the Bureau of Mines, is being contemplated by Congress. The appropriation of funds through S.B. 1243 has not yet been passed but it seems that the bill or some alternate bill will be passed. The situation is discussed, as well as other pertinent topics, in The Oil and Gas Journal, as follows: Gardner & Bell, "Estimated Costs of Mining Oil Shale in Colorado," Jan. 14, 1943, p. 47; Weil & Weinrich, "Oil Shale and Shale Oil," in two parts, April 22, p. 48, and April 29, p. 73; Frank C. Green, "Oil From Coal Requires New Mining Methods," Nov. 4, p. 68; Nelson, W. L., "Hydrogenation of Coal—Insurance for the Oil and Automotive Industries," May 8, 1941, p. 55; and the following news items, Aug. 12, 1943, p. 34; Aug. 28, 1943, p. 55, and Sept. 16, 1943, p. 27.

Although experimental work should be and probably will be initiated at once, the immediate need of gasoline from oil shale or coal is not apparent. It is likely that the development of commercial oil shale or coal-oil plants will be gradual and may not be of much significance until 1955 or 1970.

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TA-1266

# PROFITS BY GRAVITY CONTROL

AT the present time, when prevention of waste and conservation are being keynoted in all American industries, many oil operators are giving increased attention to gravity-control methods for reduction of evaporation losses. Prevention of these crude-oil evaporation losses is not only desirable from a conservation viewpoint but their reduction usually means increased profits for the operator.

Payment of premium prices for higher-gravity crude oils has provided an incentive for reducing evaporation losses wherever possible, and many operators are installing gravity-control systems on lease-tank batteries to take advantage of this price differential.

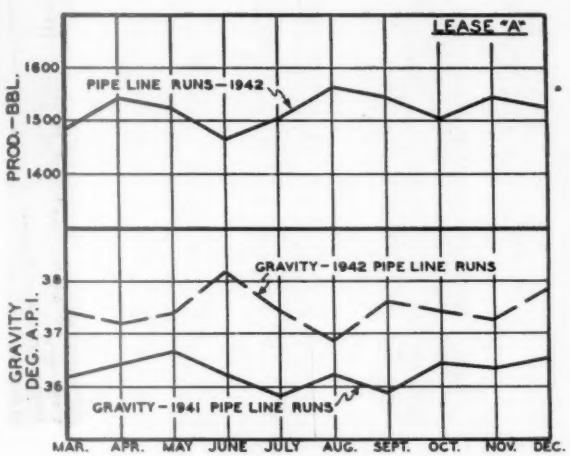


*Fig. 1*

Any oil seepage from tanks, leaks, etc., usually receives prompt attention from the operator. However, evaporation losses are not detected so readily and consequently do not always receive the attention that they deserve. Due to the present methods of producing, treating, storing and transporting crude oils, evaporation losses cannot be entirely eliminated. Redesign of tank batteries from a gravity-conservation viewpoint, usually includes general repair work and installation of suitable equipment for maintaining a slight back pressure on the tank (usually from 2 to 14 oz.)

Such equipment consists of a properly designed thief-hatch and a suitable back-pressure valve for use on the vent line. Various provisions may also be made for opening one tank without losing vapors from other tanks connected into the system. Maintenance of this back pressure serves to reduce evaporation of the lighter hydrocarbons from the liquid phase. Other than the pressure, three other factors — temperature, amount of liquid surface exposed, and degree of agitation — affect the rate of evaporation. In order to keep the tank temperature as low as possible, metal tanks are usually painted with a light-colored, heat-reflecting paint. Wood tanks provide good insulation due to the thickness of the wood staves.

### Calculating Profits

Calculation of profits from gravity control is somewhat difficult since the resultant increase in gravity is small and no convenient method for determination of the savings in oil volume is available. To offset this factor of uncertainty, the installation costs of gravity control are small and are quickly paid out if any benefits are derived from the system.

Fig. 1 illustrates the oil gravity of pipe-line runs before and after installation of gravity-control equipment on a typical lease. The amount of oil sold to the pipe line in 1942 is also shown. Production from this lease was not prorated and the resultant profits are shown in Table 1. The average oil gravity after installation of a gravity-control system at the tank battery has been compared with the average oil gravity for the same month of the previous year. The savings in oil volume was calculated on the basis of:

Savings in oil volume = increase in gravity × 0.025 × number of barrels.

The value of the increased oil volume in the present example has been calculated on the basis of $1.19 per barrel. The value of the increased gravity where the oil was raised to a higher-gravity bracket was computed on the basis of a 2-cent price differential per barrel of oil for each degree in A.P.I. gravity.

**TABLE 1—RESULTS OF GRAVITY-CONTROL INSTALLATIONS, LEASE "A"**

| Month— | 1942 production (bbl.) | Average gravity pipe-line runs | | Increase in gravity | Increased volume (bbl.) | Value of increased gravity | Value of increased volume | Total increased value of production |
|---|---|---|---|---|---|---|---|---|
| | | Before | After | | | | | |
| March | 1,490 | 36.2 | 37.4 | 1.2 | 45 | $29.80 | $53.50 | $83.30 |
| April | 1,540 | 36.4 | 37.2 | 0.8 | 31 | 30.80 | 36.90 | 67.70 |
| May | 1,520 | 36.6 | 37.4 | 0.8 | 30 | 30.20 | 35.70 | 65.90 |
| June | 1,460 | 36.2 | 38.2 | 2.0 | 73 | 58.50 | 86.90 | 145.40 |
| July | 1,500 | 35.8 | 37.4 | 1.6 | 60 | 60.00 | 71.40 | 131.40 |
| August | 1,560 | 36.2 | 36.9 | 0.7 | 27 | .... | 32.10 | 32.10 |
| September | 1,540 | 35.9 | 37.6 | 1.7 | 65 | 61.70 | 77.40 | 139.10 |
| October | 1,500 | 36.4 | 37.4 | 1.0 | 38 | 30.00 | 45.20 | 75.20 |
| November | 1,540 | 36.3 | 37.2 | 0.9 | 35 | 30.80 | 41.60 | 72.40 |
| December | 1,520 | 36.5 | 37.8 | 1.3 | 49 | 30.40 | 58.30 | 88.70 |
| Total profit from gravity control | | | | | | | | $901.20 |
| Less installation costs | | | | | | | | 226.00 |
| Net profit | | | | | | | | $675.20 |

Fig. D322

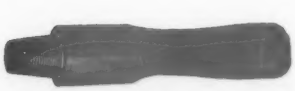

Fig. D330

Fig. D312

Fig. D335

# SPANG

## CABLE TOOLS

Fig. D360 Fig. F525 Fig. F465 Fig. F450 Fig. F501 Fig. F515 Fig. F497 Fig. F538 Fig. F482 Fig. D368

**Fig. D322**—Spang Weldless Drilling and Fishing Jars . . . forged from one piece of alloy steel.

**Fig. D330 & D335**—Heat-Treated Pin and Box for Stems and Sinkers.

**Fig. D312**—Prosser-Type Swivel Rope Socket.

**Fig. D360**—Standard-Type Straight-Blade, All-Steel Drilling Bit, with heat-treated pins.

**Fig. D-368**—Spang-Type Drilling Bit, Twisted Blade . . . most effective drilling bit available, for all formations. Insures straighter holes, lessens caving.

**Fig. F525**—Spang Patented Alligator Grab.

**Fig. F465**—Manila-Rope or Wire-Line Grab, made with either 2 or 3 prongs.

**Fig. F450**—Spang Eclipse Up-Cutting Wire Line Knife.

**Fig. F501**—Triple-Casing Spear . . . made in 2, 3 and 4 Slip Types.

**Fig. F515**—Spang Patented Reversible Splitter or Ripper.

**Fig. F497**—Combination Socket.

**Fig. F538**—Combination Trap Slip Socket, for fishing tubing and rods.

**Fig. F482**—Full-Circle Three-Slip Slip Socket.

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Engineering Fundamentals

No. 118

A WEEKLY FEATURE OF THE OIL AND GAS JOURNAL

# DENSITY OF ROTARY DRILLING FLUID

ONE of the most commonly tested properties of a drilling mud is its density. In the field, a rather loose terminology has arisen in which "weight" has been used to mean "density." At any rate, density refers to a measure of the weight of a unit volume of mud. Common units used are: pounds per gallon, pounds per cubic foot, specific gravity, kilograms per liter, and pounds per square inch per 100 ft. of depth. In the Mid-Continent and Gulf Coast fields the most generally used unit is pounds per gallon In California the units of pounds per cubic foot predominate. The trend in South American and European countries is to use kilograms per liter or specific gravity. The American Petroleum Institute has suggested the use of the units pounds per square inch per 100 ft. of depth, and many prefer these units.

Table 1 gives the relation between the various density units. It will be noted that the numerical values of specific gravity and kilograms per liter are identical. This is because of the facts that by definition the specific gravity of a mud is the ratio of the weight of a given volume of the mud to the weight of an equal volume of pure water, and pure water weighs 1 kg. per liter.

It is well for one who works frequently with mud density units to understand the conversion from one set of units to another without the necessity of referring to a table like Table 1. In order easily to do this the following facts should be remembered:

1 gal. of water weighs 8.34 lb.

1 cu. ft. of water weighs 62.4 lb.

1 cu. ft. is equivalent to 7.48 gal.

A 100-ft. vertical column of water exerts a pressure of 43.3 lb. per sq. in.

Now, suppose it is known that the density of a mud is 9.8 lb. per gal. To find the specific gravity of the mud, divide the density of the mud by the density of water in the same units. That is, in this case, specific gravity equals 9.8/8.34, or 1.18.

Suppose that another mud has a density of 73.9 lb. per cu. ft. To find its density in pounds per gallon divide 73.9 by 7.48 and obtain 9.87 lb. per gal.

Or, if it is given that a certain mud exerts a pressure of 75.5 lb. per sq. in. per 100 ft. of depth, divide 75.5 by 43.4 and obtain 1.743 as the specific gravity (or density in kilograms per liter). Now, multiply 1.743 by 8.34 and obtain 14.52 lb. per gal. as the density of the mud.

The density in pounds per cubic foot may be obtained by multiplying the specific gravity of the mud by the density of water in pounds per cubic foot, or by multiplying the density in pounds per gallon by 7.48. By the first method, the density of this mud is 1.743 by 62.4, or 108.7 pounds per cubic foot. By the second method, the density is 14.52 by 7.48, or 108.7 lb. per gallon.

Field men are usually more concerned about the density than about any other mud property. They realize that in order to prevent a blowout it is very important to maintain a high enough density that the column of mud in the hole will exert a pressure in excess of any formation pressure encountered.*

The pressure that may be normally expected at any depth in a drilling well is approximately equal to that exerted by a column of salt water of that vertical depth. Saturated salt water exerts a pressure of about 0.465 lb, per sq. in. per ft. of depth.† Since in some areas an abnormally high pressure gradient has been found, it is safest practice to allow a substantial margin of safety in favor of the mud column. Ordinarily, a safety margin of several hundred pounds per square inch (say 300 or more) is used in such cases. This is not a difficult requirement to meet since to overcome the normal pressure gradient at any depth requires a mud of only 46.5/43.3 × 8.34, or 8.96 lb. per gal.

Mud density can be maintained as high as 17.0 lb. per gal. Using this density, the pressure exerted by the mud column at 5,000 ft. would be 17.0/8.33 × 43.3 × 50, or 4,122 lb. per sq. in. It is seen, then, that a safety margin of about 1,800 lb. per sq. in. is possible at a depth of 5,000 ft. At greater depths, the possible safety margin in favor of the mud column could be even larger.

High mud density is obtained by adding heavy minerals to the mud.‡ Minerals commonly used as weighting materials are barytes and iron oxides. Ordinary clay and silt can be used to obtain a drilling fluid as heavy as 9.8 lb. per gal. If an attempt is made to use such material to further increase density, the mud becomes too viscous to pump unless a chemical "thinner" is used in conjunction with the clay. Using a thinner the weight may be carried as high as about 10.2 lb. per gal. For densities greater than 10.2 lb. per gal., the heavy minerals should be used.

**TABLE 1—RELATION BETWEEN VARIOUS MUD DENSITY UNITS**

| Lb. per gal. | Lb. per cu. ft. | Lb. per sq. in. per 100 ft. of depth | Specific gravity of kilograms per liter |
|---|---|---|---|
| 8.4 | 62.83 | 43.63 | 1.01 |
| 8.6 | 64.33 | 44.67 | 1.03 |
| 8.8 | 65.82 | 45.71 | 1.06 |
| 9.0 | 67.32 | 46.75 | 1.08 |
| 9.2 | 68.82 | 47.79 | 1.10 |
| 9.4 | 70.31 | 48.83 | 1.13 |
| 9.6 | 71.81 | 49.87 | 1.15 |
| 9.8 | 73.30 | 50.90 | 1.17 |
| 10.0 | 74.80 | 51.94 | 1.20 |
| 10.2 | 76.30 | 52.98 | 1.22 |
| 10.4 | 77.79 | 54.02 | 1.25 |
| 10.6 | 79.29 | 55.06 | 1.27 |
| 10.8 | 80.78 | 56.10 | 1.29 |
| 11.0 | 82.28 | 57.14 | 1.32 |
| 11.2 | 83.78 | 58.18 | 1.34 |
| 11.4 | 85.27 | 59.22 | 1.37 |
| 11.6 | 86.77 | 60.25 | 1.39 |
| 11.8 | 88.26 | 61.29 | 1.41 |
| 12.0 | 89.76 | 62.33 | 1.44 |
| 12.2 | 91.26 | 63.37 | 1.46 |
| 12.4 | 92.75 | 64.41 | 1.49 |
| 12.6 | 94.25 | 65.45 | 1.51 |
| 12.8 | 95.74 | 66.49 | 1.53 |
| 13.0 | 97.24 | 67.53 | 1.56 |
| 13.2 | 98.74 | 68.57 | 1.58 |
| 13.4 | 100.23 | 69.60 | 1.61 |
| 13.6 | 101.73 | 70.64 | 1.63 |
| 13.8 | 103.22 | 71.68 | 1.65 |
| 14.0 | 104.72 | 72.72 | 1.68 |
| 14.2 | 106.22 | 73.76 | 1.70 |
| 14.4 | 107.71 | 74.80 | 1.73 |
| 14.6 | 109.21 | 75.84 | 1.75 |
| 14.8 | 110.70 | 76.88 | 1.77 |
| 15.0 | 112.20 | 77.92 | 1.80 |
| 15.2 | 113.70 | 78.95 | 1.82 |
| 15.4 | 115.19 | 79.99 | 1.85 |
| 15.6 | 116.69 | 81.03 | 1.87 |
| 15.8 | 118.18 | 82.07 | 1.89 |
| 16.0 | 119.68 | 83.11 | 1.92 |
| 16.2 | 121.18 | 84.15 | 1.94 |
| 16.4 | 122.67 | 85.19 | 1.97 |
| 16.6 | 124.17 | 86.23 | 1.99 |
| 16.8 | 125.66 | 87.26 | 2.01 |
| 17.0 | 127.16 | 88.30 | 2.04 |

*Calculation of the pressure exerted by a mud column of a given density and given vertical height and of mud density required to exert a given pressure at a given depth was discussed and illustrated in Installment 5 of this series.

†See Installment 84.

‡Calculation of the amount of weighing material required to produce a given mud density was discussed in Installment 34 of this series.

Series prepared by Glenn M. Stearns, associate professor of petroleum engineering, University of Oklahoma

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# REFINING

## Kerosene Specifications Relaxed in District 1

WASHINGTON, D. C. — A relaxation of specifications of kerosene marketed in the East Coast, which, in effect, will increase its production, was ordered last week by Petroleum Administrator Harold L. Ickes.

In an amendment to the specifications for principal petroleum products marketed on the East Coast (District 1) under Directive 59, PAW ordered stabilization of kerosene and distillate fuel-oil quality on a basis that will permit greater refinery yields of kerosene without, however, impairing the quality of the products to any noticeable degree so far as heating and lighting efficiency is concerned.

Ickes explained that the fairly easy situation in lighter fuel oils, at whose expense the adjustment is made, warrants the change in order to maintain the present satisfactory, though tight, supply of kerosene.

Refiners throughout the country have already been asked to increase their kerosene yields whenever consistent with continued maximum production of essential war products. The present relaxation in kerosene specifications is expected to hasten this action by allowing refiners producing kerosene for sale in District 1 to take a deeper "cut" from the crude oil.

## Pure Oil Co. Completes New Alkylation Plant

CHICAGO.—More high-octane gasoline for Allied air forces was assured this month as the Pure Oil Co. set in operation a new alkylation plant adjacent to its Smiths Bluff refinery on the Texas Gulf Coast at Nederland, according to an announcement of Henry M. Dawes, president of the company.

"While all the company's refineries have been sending vitally important requirements to our fighting forces for many months," the announcement continued, "this new plant will materially increase our output of materials in the most critical category."

Designed to achieve the latest in technological advances and built under the Pure Oil Co.'s supervision for Defense Plant Corp., the installation produces a high-octane component which blends to make several times its quantity in 100-octane aviation gasoline. These are the components which give United States air forces that important "victory margin" over Axis fliers—the difference in performance of fuels found in tanks of enemy planes and that of the aviation gasoline the oil industry in this country is manufacturing.

Other Pure Oil Co. plants which have been turning out 100-octane or its blending components are those in Ohio at Toledo and at Newark, and at Cabin Creek, W. Va.

Forecasting yet another strike by the Pure Oil Co. in its output of high-octane aviation gasoline, Mr. Dawes indicated that the big Thermofor catalytic-cracking unit, also at its Gulf Coast refinery, is very near completion. Built and owned by the company, it will also supply butylenes to the Neches Butane Products Co., world's largest butadiene plant in the synthetic-rubber program.

## Wilshire's High-Octane Plant in Operation

LOS ANGELES, Calif. — High-octane gasoline is now in production at the new $8,500,000 plant at Norwalk, Calif., operated by Wilshire Oil Co., Inc. Ceremonies dedicating the plant were attended by Brig. Gen. Donald Stace, commanding the Western Material district, representing the Army; Rear Adm. H. F. Bruns, representing the Navy, and company officials and employes.

General Stace commended the men who built the plant in record time, and Admiral Bruns announced that record-breaking production would come from the plant. The new unit was constructed by Defense Plant Corp.

## Imperial Completes Construction at Regina

REGINA, Sask.—An extensive building program under way since 1941 has increased the crude-oil capacity of the Imperial Oil, Ltd., refinery here from 7,000 to 9,500 bbl. per day, and has expanded the output of aviation gasoline.

The program, complete for the time being, will be carried further as a postwar measure, when an additional


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crude tower and furnace will step up the capacity to 12,000 bbl. per day. New developments in petroleum technology are embodied in the design, making the plant one of the most modern in the industry. All new equipment is designed to process Turner Valley crude.

## Eleven More High-Octane Plants Now in Operation

WASHINGTON, D. C. — Eleven more 100-octane aviation-gasoline plants have been completed in the past 3 months and now are adding "thousands of barrels each day to the available supply for stepped-up offensives," according to Harold L. Ickes, petroleum administrator.

Ickes warned, however, that "the race to keep pace with expanding military operations is not yet won." Early in 1944 he said, 38 additional plants, now under construction will be completed and will "greatly augment" the volume of fighting fuel. As a result of operation of the plants less crude will be available for civilian automotive gasoline requirements since the increasing manufacture of 100-octane material will require more and more crude oil.

The 11 newest 100-octane plants make a total of 34 major aviation gasoline projects now operating.

# Sketches of Plant Operators

THOUGH only 47, William R. Newman, vice president of Frontier Refining Co., in charge of manufacturing, calls himself an old-timer. His first refinery experience was in construction of the Tallequah skimming plant at Nowata, Okla., 30 years ago. Of those days Newman says, "If it was white, looked like water and had a gravity test of over 60, it was gasoline. We paid no attention to end point, never heard of octane, and if there was a rattle in the motor it meant there was a bolt loose."

Soon after the Nowata job was finished Newman—Bill to his friends—was setting compressors in the gasoline plant which The Texas Co. was building in Tulsa. in 1918 he was helping to build the plant of the old Producers & Refiners Corp. (now Sinclair) in Tulsa. That job done, he switched his attention to operations. The cracking process was superseding skimming plants, and soon Bill was supervising 10 new cracking units for the company at Parco, Wyo. After that came supervisory positions with Old Dutch Refining Co. at Muskegon, Mich.; Independent Refining Co., Laurel, Mont.; Bay Petroleum Corp., Denver, Colo., McPherson, Kan., and Cheyenne, Wyo. The Cheyenne plant has since become Frontier, and that explains how Bill comes to be directing construction of Frontier's thermal-chemical catalytic cracking and alkylation plant, which is to make 100-octane aviation gasoline.

On his way up Newman served as trouble-shooter for Universal Oil Products Co. at plants in Kansas, Kentucky, Illinois, Arkansas, Maryland, New Jersey and Wyoming

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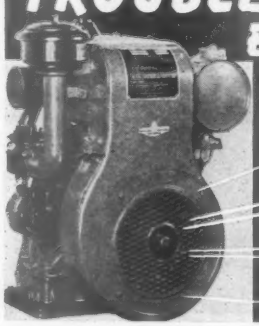

Water pumps, fans, belts, radiators, water jackets and all of their related parts and accessories are MINUS QUANTITIES on Wisconsin Engines. Complete freedom from these Trouble-Makers and their incidental high cost of maintenance and replacement represents one of the primary reasons why *your equipment* should be powered by Wisconsin Air-Cooled Engines wherever and whenever possible. Heavy-duty serviceability and all-season operating efficiency, regardless of weather, are good reasons, too.

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# Natural Gas

## OPA Grants Price Raise For Hugoton Field Gas

WASHINGTON, D. C.—An increase in the ceiling price for sweet natural gas from the Hugoton field in Kansas for manufacture of furnace black was granted last week by Office of Price Administration. The new price is 4 cents per 1,000 cu. ft. at a pressure of 16.4 lb. per square inch.

Furnace black is a product used in the manufacture of synthetic rubber.

Heretofore this gas has been selling under a flat-price contract for 2 cents per 1,000 cu. ft., at a pressure of 14.4 lb. per sq. in. The contract has now expired, and the one purchaser and the one seller are negotiating a new contract. The old price at the increased pressure is equivalent to slightly more than the 2 cents per 1,000 cu. ft.

The OPA increase will put the ceiling at a price in line with the level of prevailing prices to pipe-line purchasers in the same producing area.

The Hugoton price action was embodied in Amendment 5 to Maximum Price Regulation 436, effective December 30.

## Request Denied on More Gas for Emergency

OKLAHOMA CITY, Okla.—No immediate action will be taken by Oklahoma Corporation Commission on the application of Cities Service Gas Co. for permission to open wells in the Medrano sand zone of the West Cement field to meet an emergency demand.

Ray O. Weems, commission member, said hearing has been set for December 29 to consider nominations and other natural-gas matters and that the Cities Service request would be taken up at that time.

He pointed out that bulk of the Cities Service sales are in eastern Kansas and Missouri, principally the so-called Kansas City area. He also noted that Cities Service has a large underground natural-gas storage project in eastern Kansas, which would be drawn upon to meet emergency needs.

Specifically the gas company sought reopening wells in the Cement-Medrano area which now are shut in because of overproduction of gas in past months. Seven or eight wells have been closed since early in October and likely will not be reopened until next spring.

During the blizzard and extreme cold of 2 weeks ago the Cities Service withdrew 120,000,000 cu. ft. of gas a day from its Kansas storage farm, and at the same time discontinue deliveries of some 10,000,000 cu. ft. of gas to industrial users who had standby fuel supply.

Normally for this winter, the Cities Service is running short about 150,000,000 cu. ft. of gas a day, a conference of producers and purchasers was told here a month ago.

## Gas Rates in Kansas Towns Subject to Investigation

TOPEKA, Kans.—Investigation of gas rates charged in 97 Kansas towns by Gas Service Co., and in Welbon, Turner and Kansas City, Kans., by Wyandotte County Gas Co. is to be conducted by Kansas Corporation Commission. Revenues, practices, contracts, properties and all assets and liabilities are to be subjects of study, the commission says.

A complaint by Richard B. McEntire, the commission's' chief attorney, says earnings of the two companies were "excessive." Robert D. Garver, attorney for Cities Service Gas Co., with which the two gas companies are affiliated, denied at a hearing October 9 that the rates were excessive.

## Columbia Seeks Permission To Exchange Gas Holdings

COLUMBUS, Ohio.—Columbia Gas & Electric Corp. has asked Securities and Exchange Commission for permission to exchange properties between its wholly owned subsidiary, Ohio Fuel Gas Co., and East Ohio Gas Co. Ohio Fuel would transfer to East Ohio 74 natural-gas wells in Stark County, Ohio, as well as all rights and equipment in exchange for all the East Ohio's wells in Ashland, Coshocton, Holmes, Knox, Medina and Wayne counties, Ohio, the Shreve compressor station in Wayne County, $86,000 in cash and 1,648,647,000 cu. ft. of natural gas to be delivered during offpeak periods.

The exchange would improve location and delivery capacity in accordance with war production board suggestions for developing and maintaining adequate natural-gas supplies in Ohio, Columbia's application stated.

## Southern Union Gets Status Of Nonholding Company

PHILADELPHIA, Pa.—The request of Southern Union Gas Co., Dallas, Tex., that it cease to be classified as a holding company under the holding-company act of 1935 was granted last week by Securities and Exchange Commission. The commission reserved the right to void the grant if Southern Union should fail to divest itself of certain properties under a plan approved by the commission last September.

## Ohio Valley Gas Corp. Takes Over Indiana-Kentucky Lines

CANNELTON, Ind.—Ohio Valley Gas Corp., a newly organized company, has taken over interests of Indiana-Kentucky Natural Gas Corp., officials of the purchasing company, announced last week. Offices will be established in Tell City, Ind. All properties formerly operated by Indiana-Kentucky will be acquired by the new company. They include services in Cannelton, Tell City, Troy and Riley, as well as farm customers between Evansville and Terre Haute.

Kentucky Natural Gas Corp., a wholesale operator, holds the main gas line between Evansville and Terre Haute. Ohio Valley Gas Corp. will sell to farmers living off the main line.

## Allowables Set in Four Texas Producing Fields

AUSTIN, Tex.—Allowable production of natural gas in four Texas producing fields for January were set last week by the Railroad Commission.

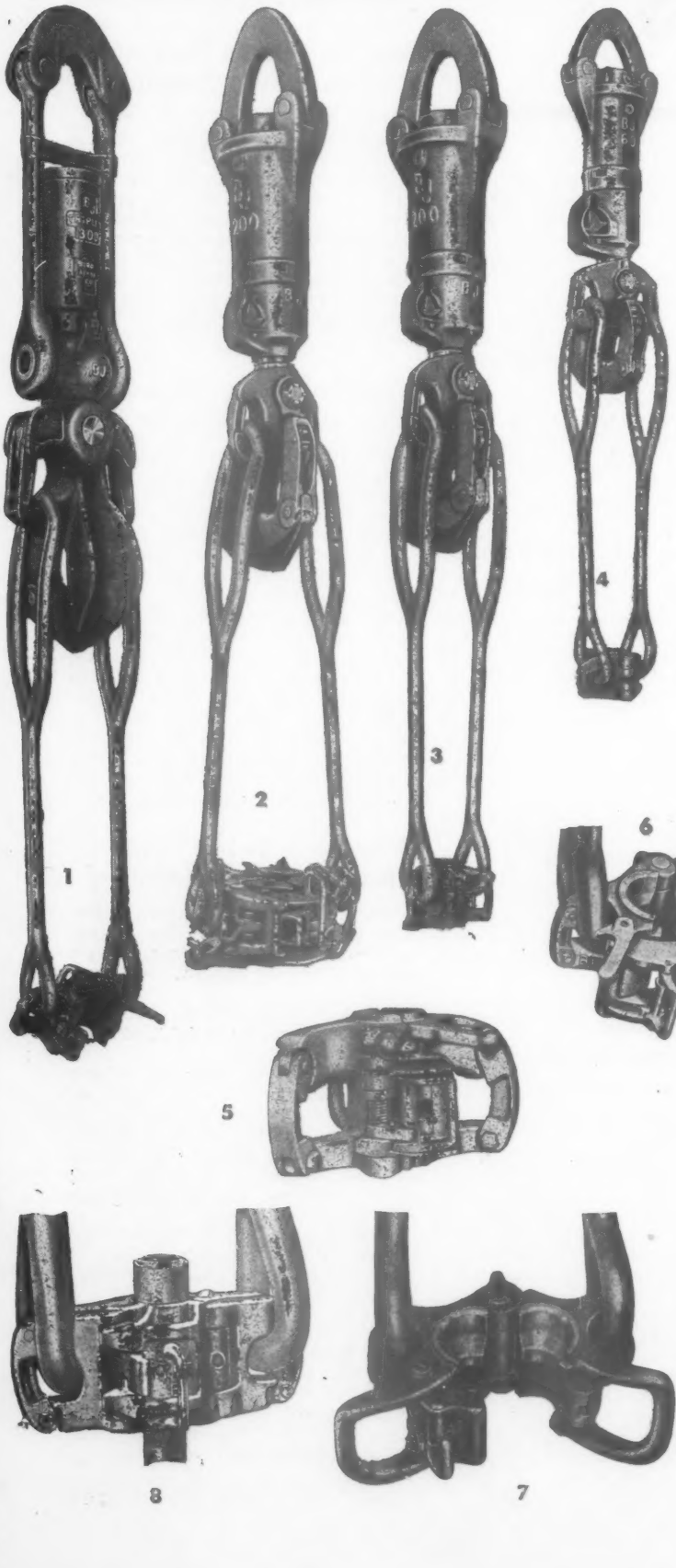
The sour-gas area of the West Panhandle field was set at 688,710,000 cu. ft. daily.

Producing properties in the Rodessa field were allocated a net daily allowable of 47,461,387 cu. ft., divided for the month between the three producing zones as follows: Dees Young sand, 206,842,000 cu. ft.; Gloyd sand, 1,100,513,000 cu. ft., and Hill sand, 163,948,000 cu. ft.

The Carthage field in Panola County was allocated daily production of 52,099,097 cu. ft., divided on a monthly schedule for the four pays as follows: Hill sand, 815,004,000 cu. ft.; upper Pettet sand, 504,996,000 cu. ft.; lower Pettet sand, 243,073,000 cu. ft., and Travis Peak sand, 51,999,000 cu. ft.

The Dabney sand allowable in the Agua Dulce field, Nueces County, was set at 25,000,000 cu. ft. daily.

# READY FOR YOUR 1944




## BJ DRILLING AND PRODUCTION TOOLS

For shallow wells or deep ones—for heavy duty rigs or portable "slim hole" outfits—there are modern BJ Hooks, Tongs, Elevators and special tools to meet your every need. A few outstanding tools are illustrated here, but you should study the 76-page section in the new 1944 Composite Catalog, or in the BJ 1944 General Catalog, gladly sent to any oil man upon request.

### BJ TRIPLEX HOOKS

At left, Fig. 1 shows a "300" Triplex Hook with the new Type AA Elevator, the perfect hook-up for handling long, heavy strings: for setting strings of casing weighing up to 200 tons, the BJ "200" Hook and BJ Slip Casing Elevator (Fig. 2) are recommended; the "200" Triplex and Type MAA Elevator (Fig. 3) form a popular hook-up for all drilling except extremely deep wells; for shallow wells, and particularly in portable rigs, the "60" Triplex Hook provides the maximum in safety and operating convenience; see Fig. 4.

### BJ ELEVATORS

The new Type AA Elevator (capacity 300 tons) and the Type MAA (capacity 150 tons) Fig. 5, promise to be the most popular elevators ever introduced in the oil fields. A positive safety latch, fully heat treated body, with flame hardened top bearing surface, and other modern features, are responsible for its prompt acceptance.—For handling external up-

set drill pipe the center latch Type G (Fig. 6) and the lighter Type LG (Fig. 7) and the side door Type B (Fig. 8) are illustrated; made also in other weights for loads from 20 to 300 tons.—The BJ Slip Casing Elevator (Fig. 9) has ample strength to carry the longest, heaviest strings of casing. The load is not carried under the coupling, but by large, non-crushing slips which set automatically when the coupling is contacted, or can be manually set at any desired point.

BJ TONGS

For heavy duty service the BJ Type B Tong (Fig. 10) fits all pipe sizes from 3½" to 10¾" by selecting the proper size lug jaw. The Type C Tong (Fig. 11) is for use on portable rigs and similar services on small diameter drill pipe. Each tong will fit all diameters from 2⅜" to 8⅝" by changing only one jaw.—The Type S Tong (Fig. 12) is ideal for use on seismograph shot hole rigs, for drilling with tubing, etc., and handles all required sizes of pipe used for such work.

BJ Elliott Wire Line Core Drills are used in all principal fields for their ability to take accurate, full-length cores from all formations combined with simplicity and safety of operation; see Fig. 13.

BJ PRODUCTION TOOLS

For handling tubing and rods there are various types and sizes of BJ Tubing and Rod Hooks, Tubing Tongs, Tubing and Rod Elevators.—The "Single" Hook (Fig. 14) may be replaced with the "Duplex" Body (Fig. 15) on BJ Combination Tubing Hooks to provide a handy combination for work-over jobs.—Snapon Tongs (Fig. 16) snap-on and lock-on the tubing, ratchet perfectly and release readily; other types are available.—BJ Tubing Catchers (Figs. 17 and 18) are low-cost insurance against a dropped or parted string of tubing.

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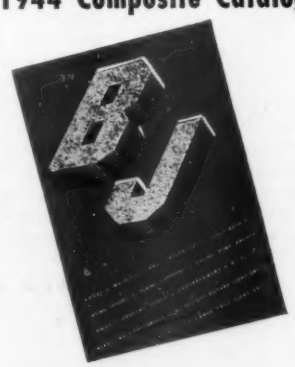

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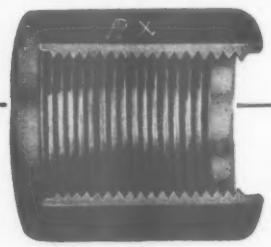

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# PIPE LINES

## Conversion of WEP 24-in. To Gas Is Considered

WASHINGTON, D. C.—The House small business committee is investigating whether completion of a natural-gas pipe line between Texas and West Virginia is justified in view of changing war conditions, Chairman Patman, Democrat of Texas, said.

Several persons, he said, had proposed to the committee that the gas pipe line be abandoned, and that one of the two oil pipe lines from Texas to the East be used instead to transport the gas. He declined to say who had made the proposal.

Easing up of the tanker and barge shortage by construction of new craft, he said, coupled with a sharp curtailment in losses through enemy action, may have altered the picture to such an extent that either the 24-in. or the 20-in. oil lines from Texas to the East might be used for gas.

Under the conversion proposal, according to information Patman said had been received by the committee, a line would be constructed from the gas fields in the Corpus Christi area to Longview, the Texas terminus of the 24-in. oil line.

According to a reported proposal Tennessee Gas & Transmission Co. will be asked to revise its plans so as to concentrate winter construction along such a Corpus Christi-Longview, Tex., route.

The committee has instructed its investigators to review all pertinent data in various government agencies which have had a hand in the authorization of both the oil and gas pipe lines, Patman declared, and to have a report prepared about the time Congress reconvenes January 10.

The chairman said the committee was interested in the new gas line, authorized to be built by the Tennessee company, from the standpoint of the effect it would have on small business enterprises in the southwest and the east.

"Our committee has been advised that this gas would be used only by a few large concerns in West Virginia and industrial sections of surrounding states," he declared. "Under the federal order by which the construction of the line was authorized, many small independent business establishments may be ruled out completely from utilization of this gas."

The line was approved as a war measure to supply eastern industrial concerns, which were said to be threatened with diminished supplies from West Virginia gas fields.

Many of these concerns now using gas could convert to coal, Patman said the committee was advised.

## WEP Deliveries Eastward Continued at High Rate

With daily throughputs of crude oil in the 305,000 to 310,000-bbl. range, deliveries of the War Emergency Pipelines, Inc., 24-in. line to East Coast refineries have continued to be well above the rated capacity despite the effect of cold weather.

WEP continues to accumulate refined products at Baytown and Beaumont, Tex., preparatory to putting the 20-in. line into operation. Pressure testing is reported to be progressing. By January 15 it is expected that the odd-numbered pump stations will be ready to operate. All stations are scheduled for completion in February.

## Michigan Consolidated Buys Two Companies

SAGINAW, Mich.—Michigan Consolidated Gas Co., exercising an option, has purchased the Big Rapids Gas Co. and Mecosta Pipe Line Co., it was announced last week by W. C Taggart, president of the Big Rapids and Mecosta concerns. Taggart said the transaction would be completed by January 1.

## Shell Develops New Rejuvenation Technique

A new procedure for pipe-line rejuvenation was used by Shell Pipe Line Corp. on about 77 miles of the Kilgore-Houston 10-in. line. The work begun in July was completed during the latter part of November, according to a recent issue of the company's publication "The Go-Devil."

The method consisted of laying a 10-mile section of new or reconditioned pipe adjacent to the operating line, tying that section into service, removing, cleaning, repairing and recoating the old pipe, and laying the latter as a new section on the stretch ahead. A temporary yard where the

old pipe was cleaned, repaired, and recoated was set up first at Livingston and then moved ahead to Apple Springs, Tex.

Considered safer because of the severe corrosion and type of welds on the old pipe, this procedure enabled the reconditioning to be done on dead pipe rather than on an operating line subjected to the pressure and weight of the oil stream. It was particularly advantageous on this job because of the hazard of fire and accident present if oil had escaped through breaks or leaks during the work. For instance, at one point, the corrosion had uniformly reduced the wall thickness to approximately ⅛-in., and the pipe snapped in two after the cutter had only made a few passes. In other places the old pipe broke when being lifted from the ditch.

When the first sections of reconditioned pipe had been welded into place and the joints painted, the upper side of the coating was found to be raised into numerous blisters ranging from minute bumps to the size of a man's fist. Since the coated pipe had been inspected in the yard and passed, the damage obviously occurred while it lay in the sun waiting to be lowered into place. After numerous experiments, O. C. Mudd, senior corrosion engineer, determined that gases or "baking soda-like" vapors were originating in chemical deposits on the old pipe. These soil deposits, peculiar to this section of East Texas, had not been completely removed by the cleaning machine nor by the subsequent application of the coating materials. Invisible to the eye, the particles of chemical under extreme solar heat slowly gave off gases which caused the coating to blister and crack. This unlooked-for blistering was eliminated only by running the pipe through a shot-blasting machine after wire-brush cleaning, and by whitewashing the coating to reduce heat absorption.

Under the general direction of L. F. Young, area superintendent, the reconditioning was done by O. R. Smith, contractor, with a crew averaging 200 men. Key Shell men continuously on the job were Carl W. Marquis who acted as chief inspector; John McKinley, assistant inspector; Bernard F. Daily, welding inspector; P. D. Harkins, coating inspector at the plant; A. M. Kimbro, coating inspector on the line; Jack Johnson, material man, and B. C. Robison, timekeeper.

## Veteran Pipe Line Gager Has 65-Year Service Record

What is probably an oil region record for continuous employment on one job with one concern has been hung up by Andrew A. McLean, of Duke Center, Pa., who is now rounding out 65 years as a gager for the National Transit Co.

And the record is still piling up as day by day this 88-year-old veteran goes about his duties for National Transit in the Bradford, Pa., field.

McLean, who is widely known throughout the Bradford field and is held in high esteem by employers and employes alike, started his oil-field career in 1878, when as a young man of 22 he journeyed to Duke Center from his home in Kennerdell, Venango County, and there secured a job cutting boiler wood for a drilling well. He then helped build rigs for drilling wells and in July of that year was hired by E. W. Longwell, foreman for the United Pipe Lines, to make grades for 25,000-bbl. iron tanks at $100 for each grade.

He finished this work on November 26, 1878, and the following day was hired by Longwell as a laborer to do construction work on pipe lines. On February 1, 1879, he was promoted to gager in one of the districts at Duke Center, and from that day forward he has continued at this work.

United Pipe Lines later became the pipe line division of National Transit, which was incorporated in 1881, so that McLean has been an employe of the company throughout its corporate life and next February 1 he will round out a full 65 years as a gager with the concern.

*ANDREW A. McLEAN*

## Sun Seeks Permit For Valley Lines

Approval by the War Labor Board has been requested by Sun Pipe Line Co. for construction of 145 miles of pipe line to properties of the Sun Oil Co. in the Rio Grande Valley and the Corpus Christi, Tex., area. The company seeks permission to construct 85 miles of 8-in. line from Harbor Island to the Seelingson, Tex., area, with a 60-mile extension of 6-in. line to Starr County in the valley where it has considerable holdings. Sun is producing more than 4,500 bbl. daily in the Rio Grande Valley district, and approximately the same amount in the Mirando area. The company is one of the most extensive operators in the valley where it has expanded its production this year. Sun already has made survey for the lines.

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# Exploration and Drilling

## Week's Highlights

EIGHTEEN special orders permitting dual completions in scattered fields of Texas were issued last week by the Railroad Commission, indicating a trend in drilling operations that is becoming more significant with each passing week. Several more applications for permits to make experimental dual completions were scheduled for hearing.

Much of the dual completion work in previous months has been handled in Texas by temporary orders allowing operating companies to produce from multiple pays on an experimental basis. Presumably, this policy gave the Railroad Commission considerable freedom in ordering modification of the technique at some indeterminate time in the future in the event unfavorable reactions should appear in neighboring properties or on the experimental lease.

Nine of last week's special orders authorizing dual completions were on wells in the Wimberly field, Jones County. Five covered wells in the Seeligson field, Jim Wells County. Other dual completion permits were scattered. However, the commission made permanent its previous experimental permits in the West Ranch field, Jackson County, "until such time as future evidence may justify the revocation of any order which granted such permission."

Extent to which dual completion operations are spreading in Texas as well as in other states is basically a reflection of crude-oil shortages and paucity of new fields available for exploitation. Furthermore, it is a reflection of the multizone possibilities in numerous southwestern fields where geologists contend inviting prospects remain for discovery of reservoirs in deeper unexplored sedimentary formations.

Among exponents of the theory that unexplored sedimentary rocks, ranging in thickness from 1,000 ft. in the northern Mid-Continent to 5,000 ft. in the Gulf Coast offer vast discovery possibilities, is A. Roger Denison, president of the American Association of Petroleum Geologists and chief geologist for Amerada Petroleum Corp. Credit to Denison for the background material in the discussion appearing on this page in the December 9 issue was inadvertently omitted. The purpose of pointing out scope of the sedimentary deposits yet untested by the drill was to show in a general way these possibilities in order that operators starting exploratory wells might make adequate provision for conclusive tests before selecting their equipment. Thus, several thousand dollars of drilling expense might be saved for the industry and if only one new field should result, the effort would be fully justified.

The current technique in dual completions and successful development of equipment to effectively segregate the multiple pays tie in directly with the broader question of encouraging complete exploration of sedimentary rocks, especially in areas of proven structural conditions. No longer need operators halt exploratory drilling for the single reason that they could produce from only one pay in any event. In fact, reports came from Washington this week that PAO 11 will be modified in the near future, liberalizing restrictions on dual completions which may invite even wide adoption of this comparatively new technique.

**CALIFORNIA:** Discovery of a new oil field in the Arroyo Grande district of San Luis Obispo County, California, may open up considerable territory for exploration work during 1944 especially since the discovery well is producing from Miocene (p. 250).

### COMPLETIONS IN ALL FIELDS . . .

(Week ended December 25, 1943)

| | Oil | Gas | Dry | Total | Footage | Total Comp. to date 1943 | 1942 |
|---|---|---|---|---|---|---|---|
| N. Y., Penna., W. Va. | 46 | 18 | 1 | 65 | 123,439 | 3,407 | 3,398 |
| Ohio | 4 | 11 | 6 | 21 | 53,121 | 938 | 1,106 |
| Indiana | 6 | 0 | 2 | 8 | 17,178 | 224 | 327 |
| Kentucky | 6 | 6 | 1 | 7 | 14,652 | 473 | 195 |
| Illinois | 20 | 0 | 10 | 30 | 67,797 | 1,774 | 1,818 |
| Michigan | 7 | 0 | 7 | 14 | 44,968 | 627 | 660 |
| Kansas | 16 | 3 | 15 | 34 | 118,298 | 1,676 | 1,503 |
| Nebraska | 0 | 0 | 0 | 0 | 0 | 28 | 34 |
| Missouri-Iowa | 0 | 0 | 0 | 0 | 0 | 18 | 13 |
| Oklahoma | 13 | 3 | 9 | 25 | 78,050 | 1,186 | 1,173 |
| Texas: | | | | | | | |
| North Central Texas | 15 | 0 | 18 | 33 | 82,397 | 1,481 | 1,019 |
| West Texas | 13 | 0 | 5 | 18 | 82,503 | 918 | 1,264 |
| Texas Panhandle | 4 | 0 | 1 | 5 | 14,973 | 183 | 327 |
| Eastern Texas | 0 | 0 | 1 | 1 | 8,438 | 309 | 387 |
| Texas Gulf Coast | 8 | 1 | 5 | 14 | 86,934 | 474 | 668 |
| Southwest Texas | 9 | 3 | 12 | 24 | 128,189 | 938 | 996 |
| Total Texas | 49 | 4 | 42 | 95 | 403,434 | 4,303 | 4,661 |
| North Louisiana | 6 | 2 | 3 | 11 | 44,320 | 343 | 474 |
| Louisiana Gulf Coast | 7 | 0 | 2 | 9 | 74,854 | 358 | 436 |
| Total Louisiana | 13 | 2 | 5 | 20 | 119,174 | 701 | 910 |
| Arkansas | 4 | 0 | 2 | 6 | 26,283 | 276 | 177 |
| Mississippi and Southeast | 1 | 0 | 4 | 5 | 19,130 | 109 | 64 |
| Montana | 5 | 0 | 0 | 5 | 13,445 | 234 | 203 |
| Wyoming | 1 | 0 | 0 | 1 | 4,675 | 133 | 108 |
| Colorado, Utah | 0 | 0 | 0 | 0 | 0 | 30 | 26 |
| New Mexico | 4 | 0 | 0 | 4 | 13,243 | 241 | 235 |
| California | 26 | 2 | 3 | 31 | 98,216 | 1,377 | 806 |
| Total United States | 221 | 43 | 107 | 371 | 1,215,104 | 17,754 | 17,417 |
| Total previous week | 247 | 54 | 138 | 439 | | | |
| Week ending Dec. 26, 1942 | 157 | 23 | 117 | 297 | | | |

## EASTERN TEXAS

### Deep Wildcat Near Manziel Pool Shows Oil

DALLAS, Tex.—Shell Oil Co., Inc. 1 Whatley, Polk Survey, Wood County, southeast of the Manziel Paluxy sand pool, was coring ahead after showing 180 ft. of 40-gravity oil on drill-stem test from 8,758-68 ft., open 20 minutes with ¼-in. top choke. It is not definitely decided whether this showing came from lower Pettit lime or upper Travis Peak, but in either event, it is enough to create interest in deeper producing possibilities in the area. The wildcat is 14 miles southwest of the New Hope field in Franklin County, which produces from both Rodessa and Travis Peak, and is 18 miles west by south of Pittsburg field in Camp County, also Travis Peak production, Moncrief and Hyde 1 R. L. Simmons, H. Nelson Survey, east of Golden, elevation 442 ft., was running low on top of Georgetown lime logged at 6,050 ft.

**Panola County.**—Another gas well for the Carthage field adds more acreage to the already large reservoir. Rogers Lacy 2 Burnett Bros., Slaughter Survey, 2 miles southwest of the operator's 1 Burnett, total depth 6,510 ft., gauged 130,000,000 cu. ft. of gas through 112 perforations opposite upper Pettit at 5,732-60 ft., and 2,150,000 cu. ft. of gas from Travis Peak pay at 6,418-30 ft. after acid treatment.

**Van Zandt County.**—Delta Drilling Co. 1 Gibson-Echols unit, Walker Survey, 3 miles northwest of Grand Saline, topped the Rodessa series at 8,215 ft. reporting favorable showings of oil, and was drilling ahead below 8,346 ft. Superior Oil Co. 1 Groves had installed pumping unit to make production test of showings of oil in Travis Peak zone at 8,565-95 ft. Previously the test had been reported as temporarily abandoned at 9,002 ft.

**EAST TEXAS WILDCAT COMPLETIONS**

Rains County: Humble Oil & Ref. 1 S. A. Mainard, 660 ft. from S'ly N, 660 ft. from E'ly E, G. E. Heard Sur., 7½ mi. SW Emory, Woodbine 4,165 ft., Georgetown 4,950 ft., Travis Peak 8,156 ft., dry at T.D. 8,438 ft.

## MICHIGAN

### Large Well Completed At Adams-Arenac

SAGINAW, Mich.—The Adams-Arenac oil field yielded another gusher and the third producer was completed in Hatton Township of Clare County to give a big boost last week to Michigan's oil production potential. The Adams well Charles W. Teater 3 Collins had a potential of 4,728 bbl. a day open flow after acid treatment, being at the rate of 197 bbl. an hour. The test was completed at 2879 ft. Ranch Oil Co. brought in the Hatton well for 1,680 bbl. potential, but the success did not cause much excitement as the area has predominated in dry holes.

Of 14 completions, seven brought crude oil. Five of the seven dry holes were wildcat tests, including two deep ventures. In Goodwell, Newaygo County, Cities Service Oil Co. went to 3,540 ft. but plugged back to Traverse at 2,787 ft. for after-acid production of 62 bbl. a day.

**MICHIGAN WILDCAT COMPLETIONS**

Arenac County, Moffatt Township: Don Rayburn 1 State-Moffatt, C N½ NW NW 33-20n-3e, dry, T.D. 2,982 ft.

Ingham County, Wheatfield Township: W. H. Colvin et al 1 Joseph G. Glaser, SE SE SE 14-3n-1e, dry, T.D. 6,599 ft.

Leelanau County, Centerville Township: F. M. Copeland and P. M. Barton 1 Louis Oberby, SE SE NE 5-29n-12w, dry, T.D. 4,307 ft.

Van Buren County, Bangor Township: Harris Oil Co. 1 F. and J. Tollar, NE NE NE 22-2s-16w, dry, T.D. 1,052 ft.

Geneva Township: W. H. Clock 1 Kerr, NW NW SE 13-1s-16w, dry, T.D. 1,122 ft.

## PERMIAN BASIN

### Dawson County Wildcat Shows Oil and Gas

MIDLAND, Tex.—Seaboard Oil Co. 1 Spraberry, NE NE Section 38, Block 34, Township 5n, T.&P. Ry. Survey, 11 miles east by south of Lamesa, indicated possible new productive spot while swabbing after drilling plug from 5½-in. casing set at 6,600 ft. The wildcat is bottomed at 7,679 ft., and has elevation of 2,919 ft. After swabbing 24 hours the fluid level stood at 3,400 ft. and the well was showing free gas, some oil and a little water.

**Andrews County.**—Frankel Bros. 1 University, NE SE Section 17, Block 13, University Survey, ¾ mile west of the recently completed south extension of the Fullerton pool, was showing for production from the Holt zone of the Clear Fork pay when it recovered an 18-ft. core from 6,125-43 ft., 10 ft. of which was porous and oil stained. Four miles northwest of the Union pool, Shell Oil Co., Inc. 1 Cox, NW SE, Section 5, Block A-31, Public School Land, was drilling below 7,080 ft. with a show of oil, rumored to have been hit in the Fullerton pay.

**Cochran County.**—Seaboard Oil Co. and Texas Pacific Coal & Oil Co. 1 Lloyd Evans, Section 15, Block Y, Public School Land, total depth 5,092 ft., set 7-in. casing at 4,850 ft., and will test saturated zone topped at 4,922 ft.

**Kimble County.**—Renfro 1 Murr, Section 7, Block 4, Dan Murray Survey, which has been fishing for lost jars, reports three small heads of oil over the mast while pulling fishing tools. The oil is coming from Bend lime at 2,350-68 ft., with 7-in. casing set at 2,190 ft.

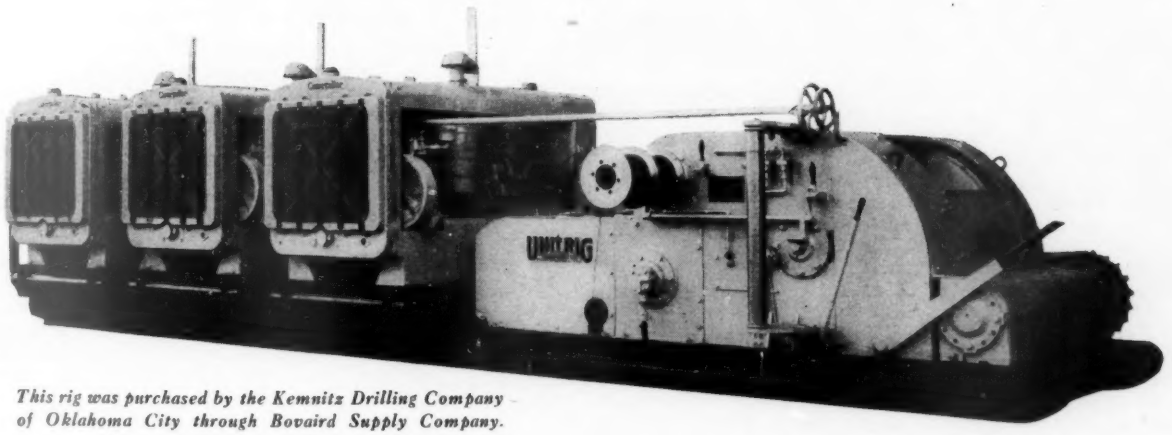
**Ward County.**—Shell 3 Sealy Estate SE NW Section 38, Block A, G.&M.M.B.&A. Survey, ½ mile west of the Monahans pool discovery, took

### DAILY AVERAGE PRODUCTION FOR WEEK

| | Dec. 25 crude oil | Distillate, allied products | Dec. PAW quota all oils | Dec. 18 crude oil |
|---|---|---|---|---|
| Arkansas | 79,180 | 4,800 | 81,700 | 78,200 |
| California | 792,750 | 47,500 | 855,500 | 797,400 |
| Colorado | 6,875 | | 7,000 | 7,600 |
| Eastern fields | 67,575 | 8,900 | 35,900 | 72,965 |
| Illinois | 210,750 | 12,700 | 227,700 | 225,350 |
| Indiana | 11,850 | | 14,400 | 14,220 |
| Kansas | 269,900 | 6,100 | 291,100 | 271,800 |
| Kentucky | 21,025 | 3,000 | 28,500 | 26,480 |
| Louisiana | 353,530 | 22,000 | 375,700 | 354,050 |
| North Louisiana | 78,030 | | | 78,550 |
| Louisiana Gulf | 275,500 | | | 275,500 |
| Michigan | 50,800 | 100 | 57,100 | 53,100 |
| Mississippi | 47,420 | | 48,000 | 47,600 |
| Montana | 23,140 | 300 | 23,800 | 20,850 |
| Nebraska | 1,600 | | 1,500 | 1,700 |
| New Mexico | 112,550 | 6,000 | 116,600 | 112,900 |
| Oklahoma | 329,100 | 28,000 | 358,000 | 325,800 |
| Texas | 1,894,700 | 126,000 | 2,018,000 | 1,894,825 |
| East Texas | 364,300 | | | 364,400 |
| West Texas | 354,400 | | | 354,350 |
| North Central Texas | 143,300 | | | 143,400 |
| East Central Texas | 126,950 | | | 126,900 |
| Texas Panhandle | 94,400 | | | 94,450 |
| Texas Gulf Coast | 711,600 | | | 711,625 |
| Southwest Texas | 99,750 | | | 99,700 |
| Wyoming | 91,895 | 3,700 | 103,700 | 96,450 |
| Total United States | 4,364,640 | 269,100 | 4,694,200 | 4,401,290 |

Total production January 1-December 25, 1943 ..... 1,476,078,785 bbl.
Same period last year ..... 1,396,122,515 bbl.

# The Battle of Production Wages on All Fronts!




*This rig was purchased by the Kemnitz Drilling Company of Oklahoma City through Bovaird Supply Company.*

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drill-stem test from 10,339 to 10,420 ft., and using 6,000 ft. of water blanket with testing tool open 35 minutes showed 1,950 ft. of water, 720 ft of water with show of gas, and 3,150 ft. of water showing oil and 300 ft. of drilling mud.

**WEST TEXAS WILDCAT COMPLETIONS**

Coke County: Harley Sadler 1 J. R. Mims, 330 ft. from N, 2,310 ft. from W, Sec. 46, Blk. W, T.&P. Ry. Sur., elev. 2,334 ft., dry at T.D. 1,851 ft.

Crockett County: John I. and P. D. Moore 1-30 J. M. Shannon, SE SW, Sec. 30, Blk. 1, G.C.&S.F. Ry., Sur., elev. 2,408 ft., dry at T.D. 2,258 ft.

Gaines County: Tide Water 1 Woodley Pet., SE SE Sec. 62, Blk. AX, Public School land, dry at T.D. 5,106 ft.

Martin County: Mid-Continent Pet. 1 J. E. Mabee, SE NW Sec. 1, Blk. 39-3n, G.& M.M.B.&A. Sur., dry at T.D. 7,536 ft.

Parmer County: Stanolind Oil & Gas 1 A. J. Jarrell, NW NE Sec. 19, Blk. 8, Capitol Lands, dry at T.D. 8,162 ft. in granite.

Sterling County: Phillips Pet. 1 "Sterling"-Glass, NW NE Sec. 3, Blk. 31, Twp. 5s, T.&P. Ry. Sur., elev. 2,468 ft., dry at T.D. 9,303 ft.

**SOUTHEAST NEW MEXICO**

HOBBS, N. M.—Barney Cockburn 1 Wyatt, SE SE 33-17s-33e, 1½ miles southeast of Maljamar and 1 mile north of the Corbin pool, indicated a new productive spot for Lea County when it showed 1,200 ft. of oil from 4,055-80 ft. while drilling ahead below 4,115 ft. The pay showing in this well is considerably higher than in nearest wells in either Maljamar or Corbin.

A minor south extension for the east side of Maljamar was seen at Williams Oil Co. 1 State, which was swabbing at the rate of 30 bbl. per day from 4,308 ft. Strong flow of gas was encountered in McLaughlin & Cosden 2 State, 7-17s-33e, which was spraying oil while trying to loosen stuck tools. The well topped pay at 4,183 ft.

West of Vacuum, H. P. Taubman 1 Sun-State, 18-17s-34e, was drilling ahead below 4,962 ft., 300 ft below the pay found in nearest producers in the field.

## LOUISIANA GULF

### Prospective Discovery Showing at White Lake

NEW ORLEANS, La.—A new field is being opened in Vermilion Parish, South Louisiana, by Union Oil Co. of California. The prospective discovery is Union 1-A State-White Lake in T-14s-2w, northwest part of White Lake, about 8 miles northwest of the company's East Whitelake field. The hole was drilled to 12,000 ft., 5½-in. set at 10,768 ft., perforations made at 10,660-75 ft. for the first test, and it flowed gas with some condensate. First perforations were squeezed off and perforations are being made at a new level for another test.

**Acadia Parish.**—Sun Oil Co. 1 W. L. Trimble, 31-9s-1w, northeast of the Egan field discovery well, set a 5½-in. liner at 10,550 ft. in the sidetracked hole, and operators drilled plug. This well was first drilled to 10,643 ft. where it tried to blow out.

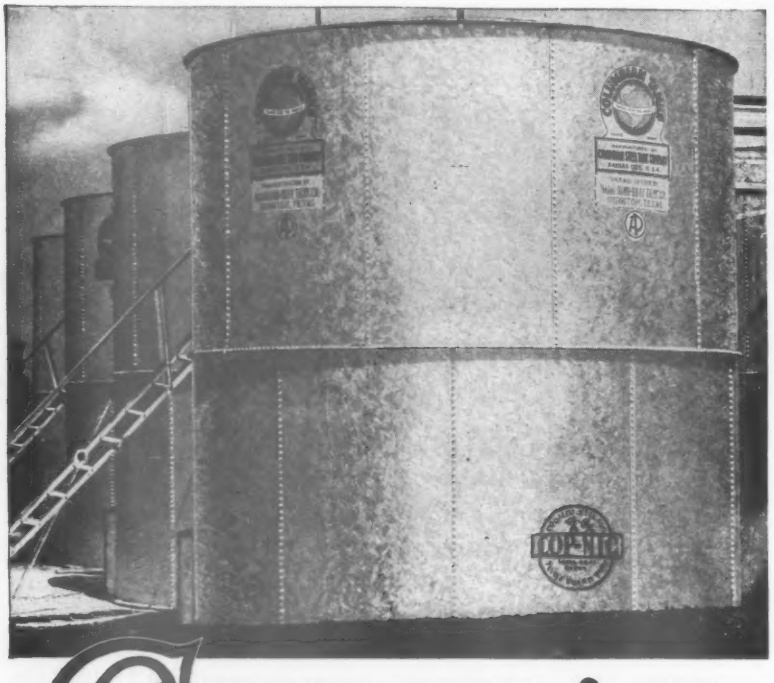
**St. Martin Parish.**—Amerada Petroleum Co. 1 Bertinot-Quebedeaux unit, Arnaudville field discovery well, 44-7s-5e, made a completion potential of 65 bbl. of 42.5-gravity oil per day through 5/32-in. choke from 87 perforations at 10,349-78 ft.

**La Fourche Parish.**—Humble Oil & Refining Co. 1 C. W. Hopkins, 1-17s-22e, Delta Farms fields, was completed for 365 bbl. daily on ¼-in. choke from 80 perforations. This is Humble's first well in the field. Location has been staked for the 2 C. W. Hopkins.

**Evangeline Parish.**—Continental & Humble 4 Pardee Lumber Co., 18-4s-1w, 1¼ miles northeast of the same operators' 3 Pardee discovery well at the Reddell field, ran electric log to 10,069 ft. to test the Sparta section from which the discovery well produces.

**LOUISIANA GULF COAST WILDCAT COMPLETIONS**

St. Martin Parish: Amerada Petroleum Co. 1 Bertinot-Quebedeaux Unit, discovery well at Arnaudville, 44-7s-5e, T.D. 10,700 ft., 5½-in. at 10,445 ft., perforated 87/10,349-78 ft., 2-in. at 10,323 ft., comp.

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# Baash-Ross News

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OIL & GAS JOURNAL EDITION

**MORE and more operators today are standardizing on *unitized* equipment for the majority of their drilling and production operations. Why? Because equipment of this type has proven *far superior* for modern field conditions. It is easier to handle, and therefore far *safer* to use. It is better designed, better engineered, and so is able to give *longer* and *more economical* service life as well as outstanding time and labor saving advantages under *all* conditions!**

## A completely unitized tool

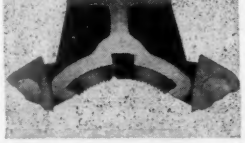
**engineered for the rigid requirements of all modern drilling operations, is the Baash-Ross Type "DU" Rotary Slip. It incorporates features proven successful through years of oil field use. It is made in both the "Regular" Type—with liners 12" long for wells to 8000 feet in depth—and the "Long" Type with liners 16" long for the deepest wells you drill. Point by point, here are the reasons why the "DU" Slip has *all* the features you want for your drilling operations. . . .**

### ▶ 3-POINT CONTACT IN MASTER BUSHING

Only in a *unitized* slip do you get the important feature of continuous, *even* setting of all slip sections around the circumference of the pipe. The Type "DU" has 3 body sections flexibly hinged together so that they set at the *same level* in the master bushing at all times. This eliminates danger of crimping the pipe, and insures a full 3-point contact in the master bushing for equal weight distribution of the drill pipe load. The flexible hinges between body sections also prevent binding, speeding up handling on every pipe connection!

### ▶ FULL LENGTH LINER RETAINERS

Two liners deeply recessed in each body section seat upon a shoulder, and are held against lateral movement by the dovetail edges of the body casting. The liners are retained firmly in the body by a long double keystone key which fits in a mating groove between them. This method of securing the liners is an important feature. It insures that all strains involved in supporting the pipe and in breaking out joints are transmitted *directly to the slip body. All retaining bolts, pins, or other means of securing the liners, which might shear and allow the liners to fall in the hole, are completely eliminated in this assembly!* Yet . . . both liners in each body section can be quickly removed by pulling one cotter key and sliding out one retaining key!



### ▶ LIGHT IN WEIGHT—BALANCED

Type "DU" Slips have ample strength to support the longest pipe strings, yet are exceptionally light in weight. The heat treated alloy steel bodies are cored to eliminate excess metal, and the tapered areas are relieved at the proper points to eliminate any tendency to stick in the master bushing bore, insuring fast, easy handling at all times. Uniform weight of each body section gives balance for ease of operation and the flattened toes enable the tool to stand solidly on the rotary or derrick floor. Large handles with loops safeguard workmen's hands and are practically indestructible. They are so designed that they rest on the rotary when released, out of the way of the descending elevators.

### ▶ FULL LENGTH LINER GRIP

An outstanding feature of the Baash-Ross "DU" Slip is the gripping surface provided by the liners. The small truncated pyramids are proportioned to insure a positive, non-slip grip on the pipe, yet hold penetration into the body of the pipe at a minimum. Distribution of load is evenly divided between all liners, and due to the flexibiltiy of the entire assembly a *full-length* grip is insured. Stress concentration at any one point is prevented by means of the horizontal and vertical relieved areas in the liners—a vitally important feature!

### ▶ INTERCHANGEABLE LINERS

To keep your slip investment at a minimum, Baash-Ross designed the Type "DU" so that each body size can be readily converted for use with a wide range of drill pipe sizes by merely installing liners of the proper size. For example, a 4½" body size will handle all sizes of drill pipe from 2⅜" O.D. to 4½" O.D. by using interchangeable liners of the specific size. Interchangeable liners are inexpensive, and can be installed right on the rig without special tools or instructions.

***Why not get the positive protection, the easier operation, the greater all-around savings provided in the Baash-Ross Type "DU" Rotary Slip? For further details on this outstanding tool, contact your Baash-Ross representative, or write direct!***

12-4-43 for 65 bbl. 42.5-gravity oil a day, 5/32-in. choke, T.P. 3,700 lb., no water, high gas-oil ratio.

## APPALACHIAN FIELDS

### Second Deep Test Started In Westmoreland County

PITTSBURGH, Pa. — On Chestnut Ridge in Derry Township, Westmoreland County, Peoples Natural Gas Co. is starting a second deep test on the Camilla Giffin farm located 1,350 ft. southeast of the No. 1 which was abandoned in the Marcellus at 8,028 ft. on the downthrow side of a fault.

#### WEST VIRGINIA

Two States Drilling Co. of Dallas, Tex., is moving a rotary from Michigan to complete Ohio Oil Co.'s deep test on the Kaemmerling tract, on the Blackwater anticline, Dry Fork district, Tucker County, West Virginia. This test reached 7,979 ft, where tools were lost, possibly the Oriskany caprock, showing a sustained gas volume of 150,000 cu. ft. The rotary will attempt to sidetrack the tools and complete as the present showing of gas warrants further exploration.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## CANADIAN FIELDS

### North Turner Extension Is Field's Best Well

CHATHAM, Ont.—Performance of a Turner Valley outpost well to the north, British Dominion 5, 17-18-2w5, indicates a strong likelihood of further extension of the field in that direction. Since its completion in June, British Dominion 5 has produced approximately 130,000 bbl., and is the largest producer in the entire field, making close to 800 bbl. daily. British Dominion 7, LSD 12, same section, the most northerly active test, found the cardium sandstone marker at 3,520 ft., indicating it will be approximately 400 ft. shallower than No. 5.

**Southern Extension.** — Possibilities of a southward extension of Turner Valley are being tested by Major-National 16, LSD 4, 9-18-2w5, spudded below 100 ft. Location is an easterly offset to Imperial-Hudson's Bay 15, the largest producer in the south end, in LSD 1, 8-18-2w4. Major-National 16 will try out a previously untested area to the south and east of production.

**Vermilion.**—In the Vermilion field, eastern Alberta, Apex 1, 7 miles southest of the proven field and 10 miles southeast of Vermilion, has encountered the richest sand yet met in the Vermilion area, and is drilling into production. A heavy gas flow was struck and shut off before entering the oil sand. Location is near the gas-producing section of the field and development indicates a large potential oil production below the gas horizon, with the opening of an extensive new area for development. Another potential extension will be tested next spring by a Toronto group represented by C. M. Goffatt of Edmonton, who has reserved 29,040 acres to the west, between Manville and the Vermilion field.

**Jumping Pound.**—In the Jumping Pound area, in the Alberta foothills west of Calgary, Shell-Norman 1, LSD 5, 22-24-5w5, finished originally at 12,056 ft., is cementing off the middle porous section of the Madison limestone after tests disclosed sulfur water, which was previously found in the lower zone. The upper zone of the lime will be tested down to 11,677 ft. and a promising section of the overlying Blairmore may be tested later. The well is the deepest in Canada.

**Aldersyde.** — On the Aldersyde structure east of Turner Valley, New Ranchmen's-Snyder 1, LSD 16, 34-19-29w4, got the Blairmore formation at

6,727 ft., logging 900 ft. higher than the Arca deep test drilled some years ago in the same general area. A substantial oil show was met at 6,930 ft. and Home sand is expected at 7,600 fit. with Dalhousie around 7,700 ft. The log indicates formation will be shallower than in many recent Turner Valley crude producers. Major production is expected in the Madison limestone around 8,000 ft.

# TEXAS GULF COAST

## Jackson Pasture Area Extended 1 Mile Southwest

HOUSTON, Tex.—A mile southwest extension at Jackson Pasture in Chambers County featured upper Gulf Coast development last week. The new well is Wynn Crosby Drilling Co. and Kirby Petroleum Co. 1 Mary Etta Mayes, Robert Oliver Survey, A-360. It was completed as a gas-condensate well in perforations 8,082-88 ft. but was shut in immediately after cleaning into pits through 7/64-in. choke. Shut-in pressure on tubing was 2,550 lb. The discovery well, drilled by the same operators several months ago, was completed as a gas-condensate producer from perforations at 8,102-08 ft., in the same sand.

While being dually completed, Phillips Petroleum Co. 1 Louis Lobit, at League City, Galveston County, blew out of control and was flowing wild at an estimated rate of 20,000 bbl. of oil per day, the flow probably coming from both sands. This test was originally completed in October 1938.

Shell Oil Co., Inc. spudded 1 William Holderrith unit in the Spring Creek area of northern Harris County, a 12,-250-ft. Wilcox test in the George Galbraith Survey, A-22.

**Harris County.** — Sun Oil Co. 1 Maurice Hirsch et al, in James H. Isbell Survey, 4 miles northwest of Huffman, was swabbed in through 40 perforations at 8,480-90 ft., and cleaned on ⅛-in. choke at the rate of 1 bbl. an hour, 25 per cent heavy paraffinic oil and 75 per cent wash water. The Texas Co. 54 Stevenson fee, deep test on the east flank of the Humble field, struck salt, halted drilling at 8,685 ft., and a squeeze job was then made at 6,525-35 ft. preparatory to testing one of the upper sands.

**TEXAS UPPER GULF COAST WILDCAT COMPLETIONS**

Brazoria County: Stanolind and Humble 1 South Texas Rice Prodn. Co., discovery well on Danbury east flank, Day Land & Cattle Co., Sur. A-601, completed and shutin pending government permit, T.D. 9,711 ft. 7-in. 9,000 ft., perf. 36/8,970-76 ft., flowed 2,500,000 cu. ft. of gas on ¼-in. choke, some condensate.

Fayette County: Joe S. Mallard 1 Herman Thiede, J. S. Robinson Sur., 1 mi. SW of Cistern townsite, dry at 1,300 ft.

Waller County: Jack W. Frazier and Victor Prassel 1 Hempstead Unit 1, Block 481, Hempstead townsite, dry at 5,059 ft.

Tyler County: Humble 1-C C. E. Goolsbee, J. B. Flieller Sur., A-903, 1.7 mi. NW of Warren townsite, dry at 7,725 ft.

# N. CENTRAL TEXAS

## Ellis Pool of Jack County Received West Extension

WICHITA FALLS, Tex.—West extension for the Ellis pool of northwest Jack County was indicated at O. J. Perren 1 Bryant, William Berryman Survey, which topped Caddo lime at 4,607 ft. and drilled lime with show of oil to 4,610 ft. It was then cored from 4,610-13 ft., recovering hard lime with stain and odor of oil, and was drilling ahead in hard lime. Rathke Oil Co. 1 Helen Slusher, wildcat in southeast Jack County, J. M. Brown Survey, had a show of oil estimated at 4 bbl. per day in drilling sand from 4,455-62 ft., going into lime at 4,470 ft., and was drilling ahead. Shell Oil Co., Inc. 1 Pursley, N. A. Slaughter Survey, 10 miles northwest of Jacksboro, which has been testing at plugged-back depth of 5,634 ft., pumped 25 bbl. oil and 15 bbl. water in 24 hours, and continued testing.

**Cooke County.** — Disappointment loomed at M. P. Springer et al 1 C. E. Marshall, Alexander Horton Survey, northwest of the Walnut Bend pool, which topped Simpson sand at 5,445 ft. and was drilling ahead below 5,780 ft. in dry lime. The test hoped to develop production from the prolific Winger sand of the lower Pennsylvania series which produces on the east side of Walnut Bend, and lies directly above the Simpson, upper Ordovician.

**Archer County.**—A flurry of drilling in the area 4 or 5 miles southeast of Archer City is occurring in search of shallow sand production. Among the more recent completions, M. W. Blair Oil Co. 3 F. J. Henry, Section 35, Block 5, Clark & Plumb Subdivision, was good for 108 bbl. per day from sand pay at 932-39 ft.

**NORTH CENTRAL TEXAS WILDCAT COMPLETIONS**

Archer County: A. R. Dillard 1-A-T L. W. McCrory trustee, 710 ft. from N, 660 ft. from E, Blk. 111, A.T.N.C.L. subd., dry, T.D. 1,528 ft.

Cooke County: F. W. Lauson 1 J. G. Bonner, 330 ft. from S and E, F. J. Lindheimer Sur., 5 mi. SE Gainesville, dry, T.D. 3,510 ft.

Jack County: Hanlon-Buchanan, Inc. 1-J Lewis Johnson, 495 ft. from S and W, 131.5-ac. tract, J. O'Neal Sur., S.S.O. 5,400-02 ft., Mississippi 5,677 rt., dry at T.D. 6,084.

Tarrant County: C. Andrade III 1 R. B. Sharpless, 660 ft. from N and E, 69-ac. tract, S. H. Thompson Sur., elev. 626 ft., Barnett shale 7,370 ft., Simpson 7,780 ft., Ellenburger 8,441 ft., dry at 8,485 ft.

Jesse Martin et al R. B. England, 440 ft. from S and W 86-ac. tract, R. Baker Sur., elev. 785 ft., Barnett shale 7,500 ft., Simpson 7,895 ft., Ellenburger 8,370 ft., dry at T.D. 8,486 ft.

Throckmorton County: Grisham-Hunter Corp. 1 R. W. Kelley, NW NW SE, Sec. 51, Comanche Indian Reserve, dry at T.D. 970 ft.

Wichita County: Bell Oil & Gas 1 Fisher & Reese, 800 ft. from N, 300 ft. from E, 150-ac. lease, dry at T.D. 2,093 ft.

H. S. and C. B. Grace 2 J. B. Dunn, 150 ft. from S, 550 ft. from W, 120-ac. tract, Wm. H. Anderson Sur., I.P. 8 bbl., pay 394 ft., T.D. 424 ft.

**WEST CENTRAL TEXAS WILDCAT COMPLETIONS**

Jones County: Great Lakes Carbon Co. 1 Essie Pearl Hall, 660 ft. from S, 330 ft. from W, 45-ac. tract, Sec. 164, B.B.B.&C. Ry. Sur., dry at T.D. 3,410 ft.

Shackelford County: E. H. R. Sabens 1 W. H. Green, 330 ft. from E, 500 ft. from S, Sec. 68, Blk. 12, T.&P. Ry. Sur., dry at T.D. 1,145 ft. Correction.

# SOUTHWEST TEXAS

## New Field Proven in Brooks County by Humble

CORPUS CHRISTI, Tex. — Humble Oil & Refining Co. 1 Scott & Hopper, discovery well of what promises to be another major oil field in the Southwest Texas district, gaged 178 bbl. of pipe-line oil per day through ⅞-in. choke with tubing pressure of 710 lb. Total depth is 6,915 ft. Oil sand was logged at 6,850 to 6,905 ft. The well also had two other oil sands and three condensate sands in the Vicksburg zone between 6,311 ft. and 6,905 ft. It is in NE SE of A.C.H.&B. Survey 107, 4 miles northeast of Alta Mesa in Brooks County. The company is preparing to start another test, the 2 Scott & Hopper, 1,320 ft. south of the discovery producer.

In Kimble County, J. C. Renfro continues to test the 1 Murr, a wildcat in T.W.N.G. Ry. Sur. 7, Block 4, about 4 miles northwest of Viejo Creek. It was bailing some oil at 2,434 ft. The 7-in. casing is set at 2,173 ft.

Humble 10 Branch, 1 mile southwest of previous 5,500-ft. production at Mayo field, Jackson County, flowed 65 bbl. of 28.3-gravity oil per day on ¼-in. choke against tubing pressure of 100 lb. from perforations at 5,430-40 ft. Total depth is 6,750 ft. This new producer is 1,000 ft. south of the 1 Branch, 6,450-ft. sand well, but failed to show commercially in the deeper pays.

Arkansas Fuel Oil Co. 1 E. Lyons, new field discovery 2½ miles south of Runge in eastern Karnes County, flowed 137 bbl. of 49-gravity oil a day on ¾-in. choke from perforations at 6,595 to 6,610 ft. in the Reklaw sand. This discovery is in the east corner of D. C. Lyons, Jr., Survey, A-382, 7 miles northeast of the Hondo Creek field which is nearest comparable production.

**SOUTH TEXAS WILDCAT COMPLETIONS**

Jim Hogg County: The Texas Co. 2 Royal R. Yaeger, R. Garza Sur. 222, A-123, 9,000 ft. NW of Armstrong field discovery, dry at 3,470 ft.

LaSalle County: Windsor Oil Co. 1 Jesse McNeel et ux, Sec. 20, Bland & Nelson subd., O'Connor Ranch, 3½ mi. N of Fowlerton, dry at 5,505 ft. in Wilcox.

Starr County: Herman and George R. Brown and J. C. Karcher 1 H. P. Guerra, Porc. 56, Juris of Mier, 17 mi. N of Roma, dry at 5,004 ft.

**LOWER GULF COAST WILDCAT COMPLETIONS**

De Witt County: Adams O. & G. Co. 1 Edward Danysh, 1 mi. SE of Yorktown, about 11,000 ft. SW of Yorktown field discovery, dry at 8,817 ft., in Wilcox.

Hidalgo County: E. A. Showers et al 1 fee, Lot 4, Blk. 19, Vista Hermosa subd., Porc. 79-80, 5 mi. NW of Mission, dry at 6,507 ft.

Karnes County: Arkansas Fuel Oil Co. 1 E. Lyons, in D. C. Lyons, Jr. Sur. A-382, 2½ miles S of Runge, 6 mi. SW of Nordheim field, 4 mi. N of Porter field, discovery well, T.D. 8,020 ft., 5½-in. 6,779 ft., perf. 71/6,595-6,610 ft., flowed 137 bbl. day, ¾-in. choke.

Nueces County: Henshaw Bros. 1 William M. Bevly, William J. Cody Sur., S½ Sec. 166, A-967, 3 mi. S of Clarkwood, ½ mi. E of Baldwin field, dry at 3,253 ft.

**SOUTH CENTRAL TEXAS WILDCAT COMPLETIONS**

Guadalupe County: W. H. Bird 1 Emma Dibrell, F. W. Hubert Sur., 8 mi. S of Seguin, dry at 2,966 ft. in Edwards lime.

Lee County: Cowan & Sorey, Inc. 2 S. T. Peeples, Joseph F. Johnson Lge., 5 mi. NW of Dime Box, dry at 3,608 ft., top Midway 3,288 ft.

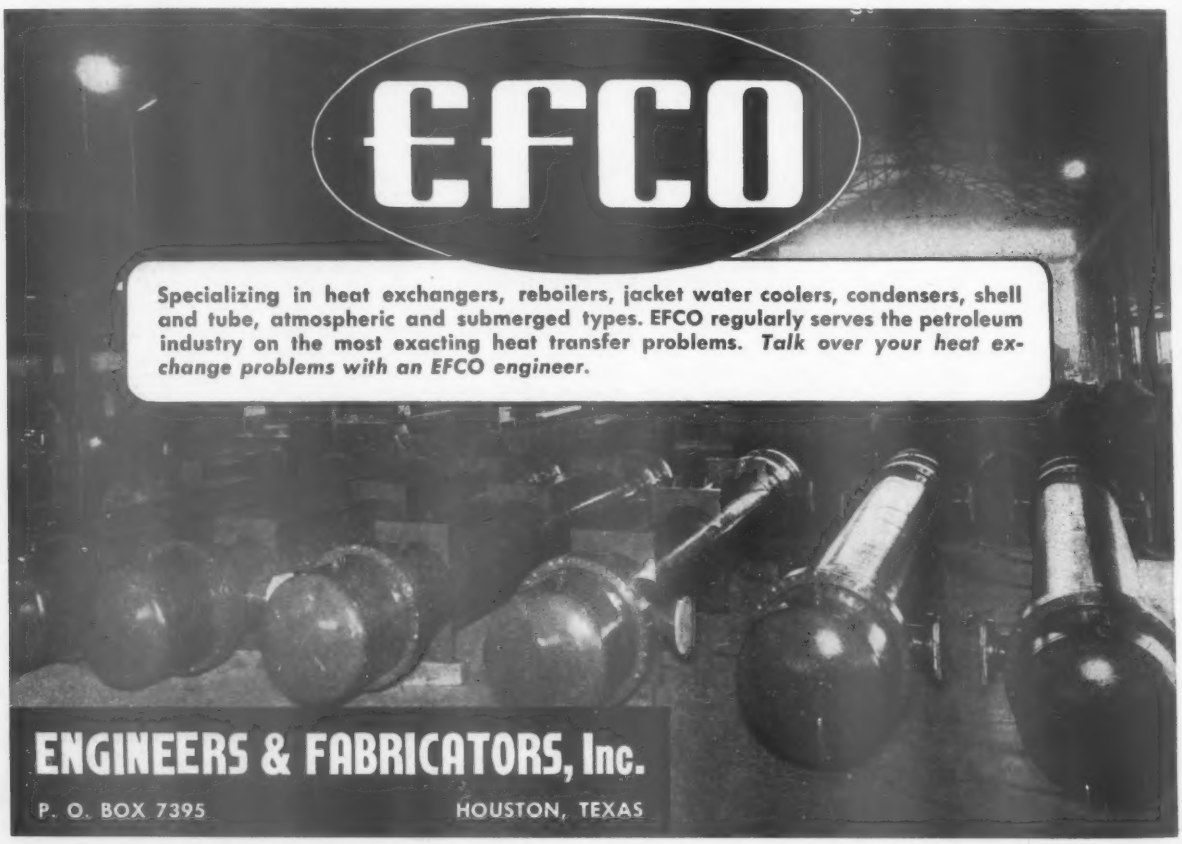
# CALIFORNIA

## State's Ninth Discovery In 1943 Completed

LOS ANGELES, Calif.—California's ninth oil field of 1943 was discovered several days ago when Los Nietos Co. completed 1 Scott in the Arroyo Grande district of San Luis Obispo County, pumping at a daily rate of 145 bbl. but which increased to 250 bbl. per day a short time later. This discovery, which was bottomed at 3,155 ft., has a 7-in. water string cemented at 3,095 ft. and a 5-in. liner landed at 3,146 ft. This wildcat cored 52 ft. of good-looking oil sand several weeks ago and the bit was still in the pay when drilling operations were concluded. For this reason the total thickness of oil sand present will remain conjectural until another well or two is drilled. The productive interval is the Pismo of probable upper Miocene age although there is some doubt regarding the age of the Pismo as it has foraminfera characteristic of the Sisquoc which is of lower Pliocene age. The transition zone is not clean cut and it has been determined to the satisfaction of all concerned that the lower part is normal Santa Margarita of upper Miocene age.

The new discovery is located in 5-32s-13w, which places it a few miles southeast of the old Edna field discovered about 37 years ago and which today only contains a few active pumping wells. If this new well holds up and shows sustained production it will probably lead to additional exploratory work in this general area which has been more or less neglected for a number of years. The lease block surrounding 1 Scott consists of large acreage and for this reason normal development may be anticipated. Actual drilling operations were done by McCarthy & O'Brien, drilling contractors.

**Los Angeles Basin.**—General Petroleum is abandoning its Norwalk wildcat in 12-3s-12w, at 10,363 ft. The last 4,000 ft. of hole showed dips as steep as 60° and while not definitely determined, it is believed the Miocene was reached. The hole failed to show anything worth testing from top to bottom. Union Oil Co. is moving into La Habra Heights and will drill a wildcat on the Sansinena property about 2 miles southeast of the Whittier field. This wildcat will be started early in January of next year. In the Long Beach field, Texas is making a production test on 1-D Field which drilled into the De Soto zone of Miocene age. The De Soto zone found in this deep test does not look any better than the same zone found in other small pumping wells in the same field.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**CALIFORNIA WILDCAT COMPLETIONS**

Arroyo Grande wildcat district, San Luis Obispo County: Los Nietos Co. 1 Scott, 5-32s-13w, pumped 250 bbl., 16.1-gravity, 5 per cent cut, T.D. 3,155 ft., perf. 3,081-3,146 ft., solid oil sand 3,102-55 ft., discovery.

Thornton wildcat district, San Joaquin County: Amerada 1 Blossom Comm., 32-5n-5e, dry, T.D. 3,592 ft., no oil or gas showings found.

Tranquility wildcat district, Fresno County: Amerada 53-12 Mendota Irrigation district, 12-14s-16e, abandoned, T.D. 5,500 ft., form. test 5,080-5,136 ft., recovered 2,215 ft. muddy salt water, no oil or gas found.

## ILLINOIS

### Large Flowing Well May Join Two Pools

MATTOON, Ill.—Pure Oil Co. established production between the Clay City and South Noble pools at its 1 L. H. O'Dese, SE NE 25-3n-8e. Drilled to 2,983 ft., it flowed 455 bbl. a day after acidizing in the McClosky at 2,973-79 ft. and 2,981-83 ft.

**Jefferson County.**—The north end of the Markham City McClosky lime pool had prospects of an Aux Vases sand well last week when Central Pipe Line Co. 1 J. T. Henry, NE SE 13-2s-4e, flowed a head of oil on a drill-stem test in the sand at 2,938-45 ft. When opened, it flowed gas in 7 minutes and oil in 45 minutes. Operators were preparing for a production test.

**ILLINOIS WILDCAT COMPLETIONS**

Shelby County: Texas 1 Ferguson, NW SE NE 18-11n-6e, dry at 3,550 ft., base of Pennsylvanian 1,581 ft., Aux Vases 2,036 ft., McClosky 2,152 ft., Devonian 3,336 ft.

Bond County: Sun 1 R. O. Young, C NE SW 7-6n-4w, dry at 2,988 ft., Trenton 2,685 ft.

Franklin County: Bell & Zoller 4 Ziegler C. & C., NW NW SW 12-7s-1e, dry at 2,806 ft., upper Kincaid 1,504 ft., Cypress 2,402 ft., Benoist 2,575 ft., McClosky 2,788-93 ft.

Ford County: Herndon Drilling 1 Fecht, SE SE SW 33-26n-9e, dry at 2,237 ft.

Edwards County: Texas 1 Pampa-Sager, C S½ NE SW 34-2n-10e, dry at 3,350 ft., Benoist 3,120 ft., Aux Vases 3,185 ft., McClosky 3,224-78 ft.

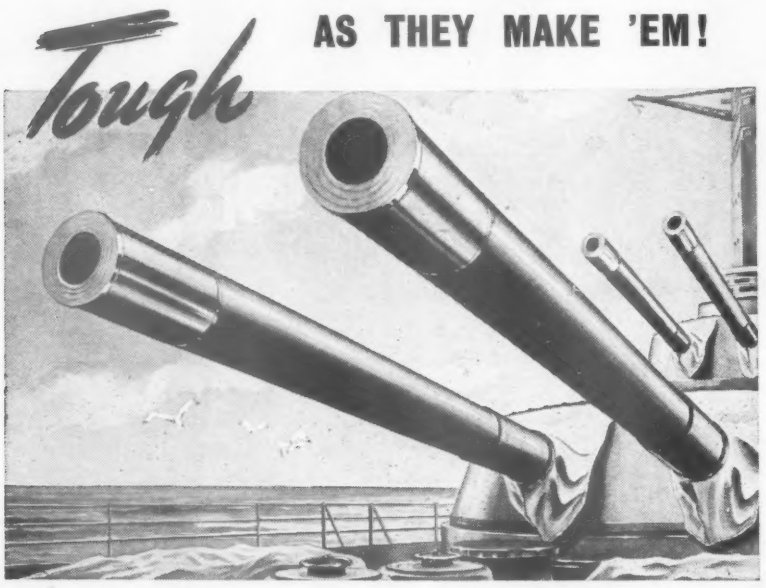
Jefferson County: Kiowa Drilling 1 Smith-Webb, SW SW SE 20-2s-4e, dry at 3,176 ft., Benoist 2,884 ft., Aux Vases 2,968 ft., McClosky 3,132-40 ft.

Washington County: E. C. Crumbie 1-A Rybacki, NE NE SE 7-3s-1w, dry at 1,408 ft., Paint Creek 1,356 ft., Benoist 1,384-85 ft.

## ROCKY MOUNTAIN

### Potential of Little Buffalo Basin to Be Tested

DENVER, Colo.—The fate of Little Buffalo Basin, Park County, Wyo., as a prospective rival to the Elk Basin field in the Tensleep horizon, still remains in doubt. The field has been producing gas from the Frontier since 1914, but was never tested to the deeper horizons until Fred Goodstein 1 Pedley-Government, NE NE NW 13-47n-100w, reached the Tensleep at 4,785 ft. early in November and found saturation in that formation. The test is now standing at 4,965 ft. with 3,465 ft. of oil in the hole while preparations are being made for a pumping test. The operator claims the well to be a discovery within the provisions of the law approved December 24, 1942, which directed the Secretary of the Interior to establish a flat royalty rate of 12½ per cent on federal leases on discoveries in new fields or deposits in producing fields. A representative of the U. S. Geological Survey is cooperating with the operator in the completion and testing of the well, but it probably will be after the holidays before a prolonged pumping test will be made. Tanks with a capacity of 1,500 bbl. are being erected and equipment is being in-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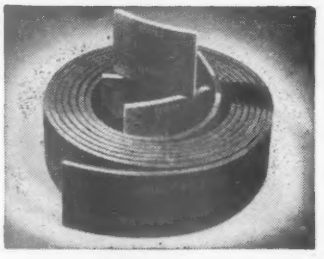

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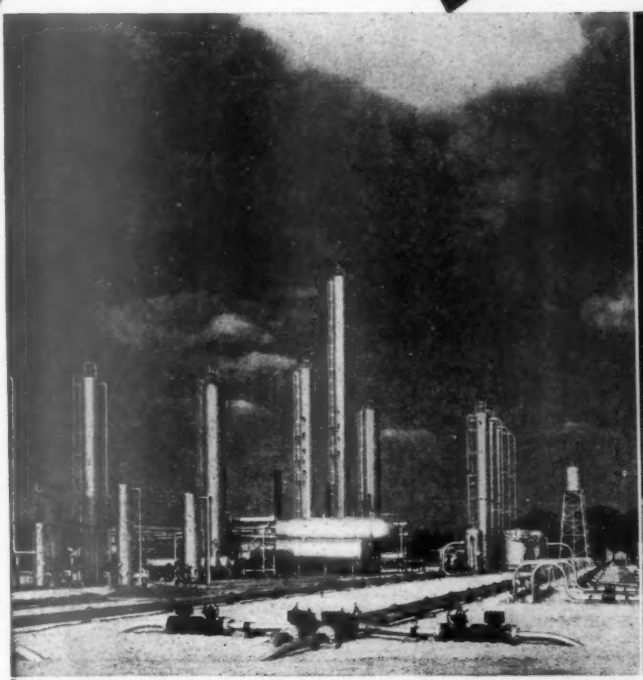

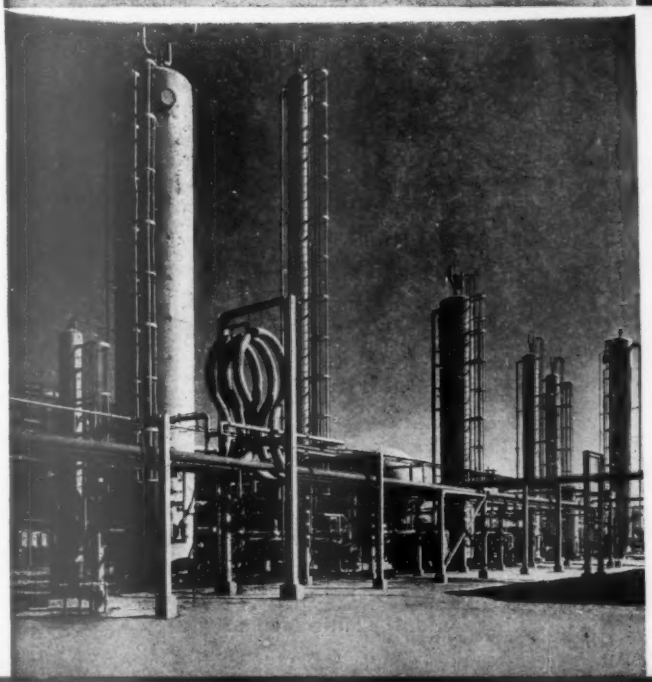

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stalled, but the necessity of complying with certain regulations, a manpower shortage and difficulties in obtaining necessary equipment has caused some delays.

The Goodstein well is on the east dome of the structure. Three and one-half miles to the northwest Stanolind Oil & Gas Co. 1 Unit, SW SW NE 34-48n-100w, a test on the west dome, is at a critical stage.

## OKLAHOMA

### Pottawatomie County Well Makes High Potential

STANOLIND Oil & Gas Co.'s wildcat, the 1 Rosebush, SW SW SW 19-8n-2e, which has been testing for several weeks, made a high pumping potential of 706 bbl. of oil in 24 hours. Pay zone is the Wilcox sand at 6,237-47 ft. Location is west of McComb and near the Pottawatomie-Cleveland county line. A new wildcat location by Stanolind, southeast of McComb, is to be watched with interest. The well is 1 Ferrell, NW NW NW 9-7n-3e, and is on a block that has been seismographed by both Stanolind and Amerada.

**Oklahoma County.**—A ½-mile east extension to the West Edmond pool was in prospect at D. D. Bourland 1 Myrtle French, NW NW 33-14n-4w. Drilling was going ahead below 6,853 ft. in saturated Hunton lime.

**OKLAHOMA WILDCAT COMPLETIONS**

Seminole County: B. A. Reardon 1 Harjo, SW SE 24-6n-6e, dry, T.D. 1,640 ft.

Northern Ordnance 1 Gunn, SE SW NE 29-11n-8e, dry, T.D. 3,748 ft., Gilcrease 3,421 ft., Cromwell 3,550 ft.

## KANSAS

### One Discovery Completed, Others Are Testing

ONE small pumper was completed as a pool opener last week and a number of wildcats had good showings. In Stafford County, about 2 miles west of the Richardson pool, Hershfield et al finished their 1 Heyen, NW NW 24-22-12w. This well looked promising when it filled 2,000 ft. with oil in 2 hours and swabbed 120 bbl. in 15 hours, but the last hour bottom-hole water made up 75 per cent of the fluid. It was completed at 96 bbl. a day in the Arbuckle at 3,649-51 ft., plugged back from 3,654 ft. The tentative name for the new pool was Heyen.

**Barber County.**—Deep Rock Oil Corp. 2 Skinner, SW SW SE 29-31-14w, southeast of the Sun City area, continued testing. It flowed an estimated 20 bbl. of oil an hour, natural, and after acid pumped 151 bbl. in 16 hours. Pay is the Viola lime at 4,624-40 ft.

**Rooks County.**—Continental Oil Co. is opening a new pool, southeast of Morel, at its 1 Brueggeman, NE NE NE 5-10-20w. This was an old stratigraphic test reamed out and in the first tests it produced 50 bbl. of oil an hour. Total depth is 3,843 ft. in Arbuckle lime topped at 3,823 ft. Three miles to the southeast, Champlin Refining Co. 1 Marcotte, SE NE SW 15-10-20w, had a showing of oil in the Arbuckle at 3,253-64 ft.

**KANSAS WILDCAT COMPLETIONS**

Barber County: Auto-Ordnance 1 Nat'l. Gypsum, SW SW NW 10-31-15w, dry, T.D. 4,906 ft., Viola 4,671 ft., Arbuckle 4,856 ft.

Ellis County: Phillips Pet. 1 Harman, SE SE SE 1-12-19w, dry, T.D. 3,880 ft., Arbuckle 3,850 ft.

Ellsworth County: Shell 1 Brejcha, NE SE NW 5-17-10w, dry, T.D. 3,458 ft., Topeka 2,657 ft., Arbuckle 3,365 ft.

Graham County: Bridgeport Oil 1 Balthazor, NW SE SE 34-8-21w, dry, T.D. 3,743 ft., Arbuckle 3,693 ft.

Pratt County: Mid-Continent 1 Walsh, SW SE SE 1-27-12w, dry, T.D. 4,570 ft., chat 4,148 ft., Arbuckle 4,519 ft.

Reno County: Nelson Drlg. 1-A Bacon, NW NE NE 36-23-5w, dry, T.D. 3,896 ft., Viola 3,871 ft., Hunton 3,744 ft.

Rice County: Barnett Drlg. 1 Dresher, NW SW NW 31-19-7w, dry, T.D. 3,590 ft., Viola 3,450 ft., Arbuckle 3,568 ft.

Stafford County: Hershfield et al 1 Heyen, NW NW 24-22-12w, pumped 96 bbl., Arbuckle 3,649-51 ft., T.D. 3,654 ft.

Franco Central and Hinkel 1 Freymiller, SW SW 31-25-11w, dry, T.D. 4,288 ft., Viola 4,073 ft., Arbuckle 4,252 ft.


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## OHIO, KENTUCKY

### New Oil Sand Found In Monroe County

ZANESVILLE, Ohio.—A discovery by the South Penn Oil Co. in Center Township, Monroe County, in the Warren sand has caused considerable leasing activity. The well, on the Kerr farm in Section 6, flowed 37 bbl. of oil the first day and 59 bbl. the second. The sand, found at 3,057-62 ft., is 945 ft. below the Berea and is one of many producing sands found bedded in the Ohio shale in Pennsylvania, but never before drilled to in this area of southeastern Ohio. The well was drilled to 3,071 ft., shut down and allowed to flow without agitation for testing. The oil tested 50-gravity A.P.I.

The H. K. Porter Co. found a fair gas well in a wildcat test 6 miles north of the West Zanesville pool in Section 22, Muskingum Township, Muskingum County. The well, on the Lilly Weaver tract, gaged 497,000 cu. ft. with a rock pressure of 1,225 lb. from the Clinton at 3,501-43 ft.

**OHIO WILDCAT COMPLETIONS**

Muskingum County, Blue Rock Township: Industrial Gas 1 Robert Finley, Sec. 28, Clinton 4,395-4,401 ft., dry, T.D. 4,492 ft.

Muskingum Township: H. K. Porter 1 Lilly Weaver, Sec. 22, Clinton 3,501-43 ft., 497,000 cu. ft., T.D. 3,559 ft.

Tuscarawas County, Mill Township: James Upham 1 Robinson & Son, Lot 21, Clinton 5,092-5,151 ft., dry, T.D. 5,218 ft.

## EASTERN KENTUCKY

ASHLAND, Ky. — Drilling operations in the eastern Kentucky fields maintained a steady pace during the week but no completions were reported. Cold weather has failed to bring a definite slowdown and a few new locations were filed.

## INDIANA

EVANSVILLE, Ind.—Posey County's two recent sand discoveries have promises of giving the state an important development campaign. Bennett Brothers 1 Spencer, NE SE SW 32-62-14w, was ready to go on the pump after swabbing 15 bbl. of oil an hour. Previously the well made a flow of 512 bbl. in 24 hours in Tar Springs sand at 2,142-49 ft. The other well, Sells Petroleum Co. 1 Wade, W½ SW NE 14-5s-14w, was waiting on cement after setting 7-in. casing at 2,446 ft. in the Hardensburg sand. A drill-stem test at 2,455-69 ft. started flowing gas in 20 minutes and recovered 1,340 ft. of oil. A production test was to be made later in the week. New locations in this area are: Carter Oil Co. 1 Gould, SE NE SW 32-6s-14w; Calstar Petroleum 1 Hickman, SW NE NE 14-5s-14w, and Bennett Brothers 1 Shoultz, SE SW SE 29-6s-14w.


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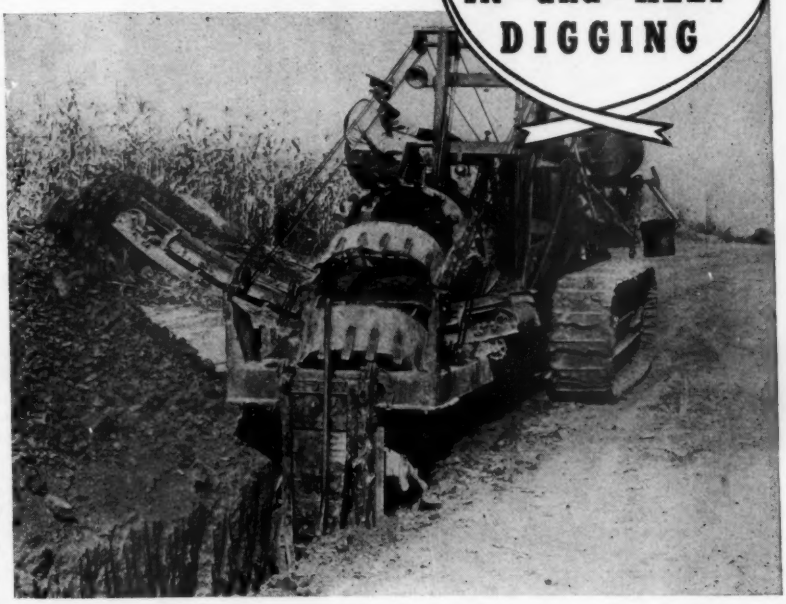

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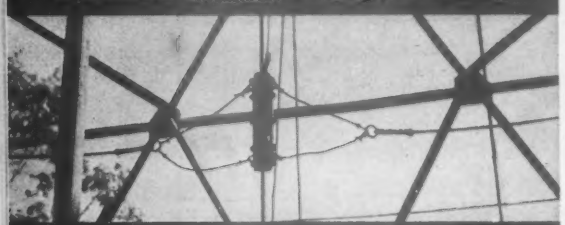

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### PISTOLA DE LODO SUPER UNIVERSAL

3. El más reciente tipo. De acero fundido, con doble paso compensado, para trabajo en que el lodo se inyecta sobre una base de 24 horas. Se cierra en cualquier posición. Puede equiparse con múltiple de 4 vias.

### LIMPIADOR DE TUBO Y TUBERIA

4. Disco de caucho de una sola pieza, reforzado, de trabajo pesado. Se loca debajo de la plataforma. Limpia muy bien el tubo y la tubería. Evita que las herramientas caigan en el agujero. Ahorra agua da lavar. Tamaños de 9 a 9".

### LIMPIADORES DE VARILLA DE BOMBA

5. So ofrecen en dos tipos: normal y universal. Ilustramos aquí este último. Caja compacta. El tipo de arriba está equipado con caja de dob cierre. Dos discos de completa flotación limpia efectivamente la varilla de bomba.

### LIMPIADORES DE CABLES DE ALAMBRE

6. Dos estilos—estilo A y estilo B. Ilustram aquí este último. La caja de acero del tipo B co tiene el bloque de caucho y se sujeta por grapas d r sorte. La pieza de acero fundido está abisagrad

### GUIAS DE CABLES DE ALAMBRE

7. Se usan en todos los trabajos de perforació Dan protección a los cables de alambre. A prueb de chispas. Evitan la vibración. Aseguran correct arrollamiento. No hay astillas que salten a los ojo de los trabajadores. Se ofrecen en varios tamaño

### LIMPIADORES DE KELLY

8. Disco de caucho que limpia al kelly de todo e lodo. Se ofrece con aberturas rectangulares, hexa gonales u octagonales. Se inserta dentro del bu del kelly. Accesorios o guarniciones especiales.

### AMORTIGUADORES DE ASAS DE ACHICADO

9. Evitan el desgaste de las asas y soportes de evevador. Eliminan el contacto de metal contr metal entre las articulaciones y el soporte gira torio del elevador. El bloque amortiguador d caucho se ajusta a todo tipo de soporte giratorio.

***See Composite Catalog***

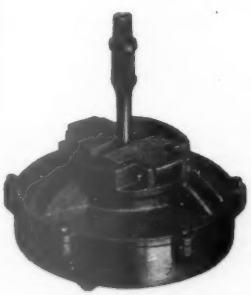
**PATTERSON-BALLAGH**
**CORPORATION**
*Plant:* 1900 E. 65th St., Los Angeles, Calif. *New York Export Office:* 92 Liberty St.
*Mid-Continent Office:* 1506 Maury St., Houston, Texas

**LIP PROTECTORS**

Latest development in all-rubber Protectors. An exclusive Patterson-Ballagh improvement. Heavy lips added at top and bottom give full streamlining; prevent drill pipe from "ringing." All sizes.

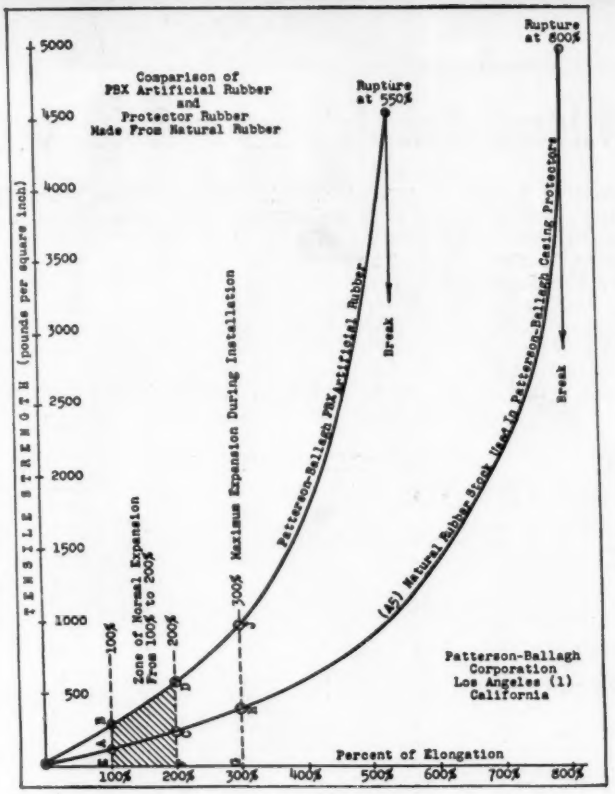
**SUPER UNIVERSAL MUD GUN**

Latest type. Heavy cast steel, double balanced flow, for operations where mud is jetted on 24-hour basis. Locks in any position. Can be equipped with 4-way manifold.



**SUCKER ROD WIPERS**

1. Made in two types, Standard and Universal. The latter is illustrated. Compact housing. Two freely floating discs effectively wipe rods.




Comparison of the strength characteristics of rubber used in Products made of PBX Artificial Rubber and the same Products when made of Natural Rubber.

## PBX Synthetic Rubber and How It Compares With the *Natural*

Tests made of Patterson-Ballagh's new PBX Synthetic Rubber prove its ability to permit an expansion of far greater than the extreme requirement of 200% without harm.

It is true that artificial rubber will rupture at a lower breaking point than natural rubber. Rupture of PBX rubber occurs at 550% elongation at a tensile stress of 3600 pounds per square inch. But no such strain is ever imposed on a Protector.

Within a range of stress in actual service on the drill pipe the tensile characteristics of PBX rubber are actually superior to natural rubber, as indicated in the accompanying graph.

Consequently, PBX products embody new qualities of stamina far beyond the popular expectations of artificial rubber.

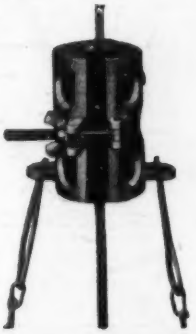
This is good news to the hundreds of Patterson-Ballagh customers who have been fearful that when stocks of natural rubber became exhausted, it would end the supply of Protectors, Pipe Wipers, Wire Line Wipers, Wire Line Sucker Rod Wipers, Mud Gun Nozzles, Guides, and Swivel Bail Bumpers for the duration.

**STABILIZERS**

2. For open hole drilling. Stabilize the pipe. Reduce whip in pipe. Prevent excessive tool joint wear. Rubber specially cured, uniform throughout.

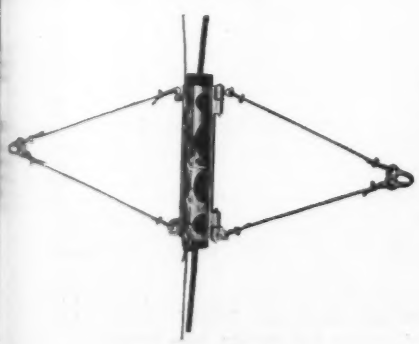
**PIPE & TUBING WIPER**

4. Heavy-duty one-piece rubber disc, reinforced. Sets under table. Strips pipe and tubing cleanly. Prevents tools dropping into hole. Saves wash water. Sizes 9" to 19".



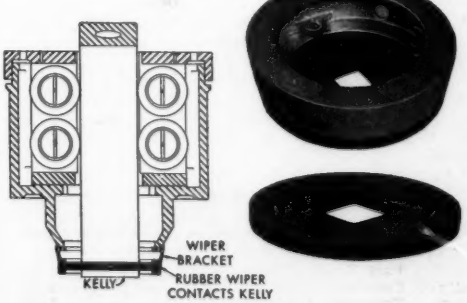
**WIRE LINE WIPERS**

6. Two types—Style A and Style B. The latter is illustrated. Steel housing of Type B holds rubber filler block and is held by spring clips. Steel casting is hinged.



**WIRE LINE GUIDES**

7. Used in every drilling field. Saves wire line. Spark-proof. Prevents vibration. Assures proper spooling. No splinters to fall in crew's eyes. Made in various sizes.




**KELLY WIPERS**

8. Heavy rubber disc completely strips Kelly of mud. Available with square, hexagonal and octagonal openings. Inserted within Kelly bushing. Special fittings.

**SWIVEL BAIL BUMPERS**

9. Prevent wear on swivel and elevator bails. Keep elevator links free from metal-to-metal contact with swivel. Rubber bumper block fitted to castings for every type of swivel.

# Wildcat Completions and Discoveries

EIGHT discoveries completed last week compared with the previous week in number but were scattered more throughout the country. In the Arroyo Grande district of San Luis Obispo County, California, Los Nietos Co. 1 Scott pumped 250 bbl. of low-gravity oil a day to open a new field southeast of the 37-year-old Edna pool. It is expected to open a large area for further drilling.

A 137-bbl. well in Karnes County, lower Gulf Coast Texas, was finished by Arkansas Fuel Oil Co. at its 1 Lyons. The producing zone is at 6,595-6,610 ft. and the flow is through ¾-in. choke. Location is 4 miles north of the Porter field, nearest production.

Amerada Petroleum Co. 1 Bertinot-Quebedeaux, discovery of the Araundville pool, St. Martin Parish of Gulf Coast Louisiana, was pinched in and completed at 65 bbl. of 42.5-gravity oil a day through 5/32-in. choke. There was a high gas-oil ratio but no water.

In Union County, Arkansas, Phillips Petroleum Co. completed its Rainbow City extension well, pumping 248 bbl. of oil a day. Production here is a low-gravity black oil, found in the Tokio sand at 2,770 ft., plugged back depth from 5,835 ft.

## WILDCAT COMPLETIONS

| | Week ended December 25, 1943 | | | | | Cumulative total for 1943 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Oil | Distillate | Gas | Dry | Total | Oil | Distillate | Gas | Dry | Total |
| Ohio | 0 | 0 | 1 | 2 | 3 | 4 | 0 | 25 | 58 | 87 |
| Indiana | 1 | 0 | 0 | 1 | 2 | 5 | 0 | 0 | 53 | 58 |
| Kentucky | 0 | 0 | 0 | 1 | 1 | 22 | 0 | 2 | 115 | 140 |
| Illinois | 0 | 0 | 0 | 7 | 7 | 79 | 0 | 3 | 405 | 487 |
| Michigan | 0 | 0 | 0 | 5 | 5 | 11 | 0 | 3 | 177 | 191 |
| Kansas | 1 | 0 | 0 | 8 | 9 | 56 | 0 | 1 | 366 | 423 |
| Nebraska-Missouri-Iowa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 26 | 26 |
| Oklahoma | 0 | 0 | 0 | 2 | 2 | 42 | 1 | 19 | 253 | 314 |
| Texas: | | | | | | | | | | |
| North Central | 1 | 0 | 0 | 9 | 10 | 61 | 0 | 1 | 364 | 426 |
| West | 0 | 0 | 0 | 6 | 6 | 14 | 0 | 1 | 91 | 106 |
| Panhandle | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 6 |
| East | 0 | 0 | 0 | 1 | 1 | 5 | 1 | 2 | 105 | 113 |
| Gulf Coast | 2 | 0 | 1 | 6 | 9 | 9 | 8 | 8 | 141 | 166 |
| Southwest | 0 | 0 | 0 | 5 | 5 | 26 | 11 | 7 | 271 | 315 |
| Total | 3 | 0 | 1 | 27 | 31 | 115 | 20 | 19 | 978 | 1,132 |
| Louisiana: | | | | | | | | | | |
| North | 0 | 0 | 0 | 4 | 4 | 6 | 0 | 4 | 71 | 81 |
| Gulf Coast | 1 | 0 | 0 | 0 | 1 | 15 | 9 | 1 | 31 | 56 |
| Total | 1 | 0 | 0 | 4 | 5 | 21 | 9 | 5 | 102 | 137 |
| Arkansas | 1 | 0 | 0 | 2 | 3 | 3 | 0 | 0 | 63 | 66 |
| Mississippi and Southeast | 0 | 0 | 0 | 1 | 1 | 6 | 0 | 0 | 72 | 77 |
| Montana | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 4 | 26 | 37 |
| Wyoming | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 1 | 15 | 24 |
| Colorado, Utah | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 8 | 9 |
| New Mexico | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 2 | 29 | 37 |
| California | 1 | 0 | 0 | 2 | 3 | 8 | 0 | 10 | 141 | 159 |
| Total United States | 8 | 0 | 2 | 62 | 72 | 392 | 30 | 95 | 2,887 | 3,404 |
| Total previous week | 8 | 0 | 4 | 67 | 79 | | | | | |

## LA.-ARK.

### Phillips Discovery Is Completed in Tokio Sand

SHREVEPORT, La.—Phillips Petroleum Co.'s wildcat in Union County was completed last week after a number of production tests. The well, 1 U. S. Minerals, in NW SE NE 9-17s-13w, was drilled to 5,835 ft. but plugged back to the Tokio sand at 2,770-74 ft. to complete at 248 bbl. of oil a day on the pump.

**ARKANSAS WILDCAT COMPLETIONS**

Grant County, SE of Lamont: Hunt Oil Co. 1 Thornton, NW NE 23-7s-1e, dry, T.D. 4,651 ft.

Union County: Phillips Petroleum Co. 1 U. S. Minerals, NW SE NE 9-17s-13w, pumped 248 bbl., Tokio sand 2,770-74 ft., T.D. 5,835 ft.

H. L. Hunt 1 L. Myers, SE SE NE 3-19s-1w, dry, T.D 7,217 ft.

**NORTH LOUISIANA WILDCAT COMPLETIONS**

Bossier Parish: Carter Oil Co. 1 S. H. Bolinger, SE NW 20-22n-1w, dry, T.D. 10,000 ft.

Morehouse Parish: Union Producing Co. 1-C Crossett, SW SW 9-23n-6e, dry, T.D. 6,115 ft.

Webster Parish: H. H. Temple 1 Woodward-Walker, E½ NE SW 9-17s-8w, dry, T.D. 1,872 ft.

R. J. Montgomery 1 Hartman, SW SW SW 31-20n-10w, dry, T.D. 735 ft.

**MISSISSIPPI**

A new oil field for Mississippi is being opened by Gulf Refining Co. at the 1 Ellen Morrison, 660 ft. north and west of SE cor. SW SE 30-1n-13e, in Jasper County. Drill-stem test was run at 4,910-36 ft. and recovered 600 ft. of pipe-line oil of about 33 gravity. Casing will probably be set for completion trial in this sand.

**FLORIDA WILDCAT COMPLETION**

Madison County: Hunt Oil Co. 1 J. W. Gibson, NE NW 16-1s-11e, dry, T. D 3,024 ft.

## CRUDE-OIL PRICES

Representative selected crude prices from all sections of the country appear below:

| | |
|---|---|
| East Texas | $1.25 |
| Conroe | 1.43 |
| Tepetate, Louisiana | 1.18 |
| Illinois basin | 1.37 |
| Pecos County, Texas | .95 |
| Bradford, Pennsylvania | 3.00 |
| Van, Van Zandt County, Texas* | 1.00 |

*No change since 5-21-41.

### Gravity Schedules

Top prices include all gravities above grades designated, and low prices include all gravities below grades designated:

| Gravity— | Signal Hill, Calif. | Oklahoma, Kansas | Gulf Coast Texas | West Texas* |
|---|---|---|---|---|
| 18-18.9 | $0.80 | | $1.06 | $0.70 |
| 19-19.9 | .84 | | 1.08 | .72 |
| 20-20.9 | .88 | $0.85 | 1.10 | .74 |
| 21-21.9 | .92 | .87 | 1.12 | .76 |
| 22-22.9 | .96 | .89 | 1.14 | .78 |
| 23-23.9 | 1.00 | .91 | 1.16 | .80 |
| 24-24.9 | 1.03 | .93 | 1.18 | .82 |
| 25-25.9 | 1.07 | .95 | 1.20 | .84 |
| 26-26.9 | 1.11 | .97 | 1.22 | .86 |
| 27-27.9 | 1.15 | .99 | 1.24 | .88 |
| 28-28.9 | 1.18 | 1.01 | 1.26 | .90 |
| 29-29.9 | 1.20 | 1.03 | 1.28 | .92 |
| 30-30.9 | 1.23 | 1.05 | 1.30 | .94 |
| 31-31.9 | | 1.07 | 1.32 | .96 |
| 32-32.9 | | 1.09 | 1.34 | .98 |
| 33-33.9 | | 1.11 | 1.36 | 1.00 |
| 34-34.9 | | 1.13 | 1.38 | 1.02 |
| 35-35.9 | | 1.15 | 1.40 | 1.04 |
| 36-36.9 | | 1.17 | 1.42 | 1.06 |
| 37-37.9 | | 1.19 | 1.44 | 1.08 |
| 38-38.9 | | 1.21 | 1.46 | 1.10 |
| 39-39.9 | | 1.23 | 1.48 | 1.12 |
| 40 and above | | 1.25 | | |

*Includes Lea County, New Mexico.

# EDWARD 6000 LB HYDRAULIC VALVES

## FOR PUNISHING PRESSURES

FIG. 158 GLOBE

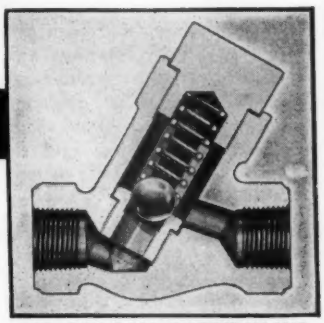


FIG. 160 BALL CHECK VALVE

THOUSANDS of excessive pressure systems operating under 300 F depend on Edward Fig. 158 globe hydraulic valves for fast, certain shut-off or accurate pressure control.

The seat and swivel needle disk are made of EValloy, Edward's own development in abrasion resisting stainless steel. The inside screw construction, the extra deep stuffing box and the special gland and packing nut design lengthen packing life and prevent leakage along the stem. Streamlined body contours permit free flow at high velocities with low pressure drop.

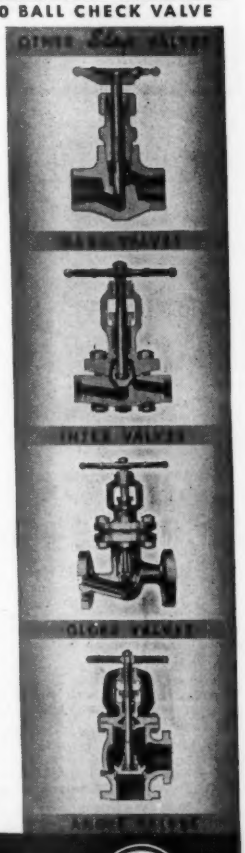
These—and other—specific advantages of Edward Fig. 158 valves add up to savings in maintenance time and replacement parts. For information on valves in the Edward line write for Edward BETTER VALVES Catalog No. 101.

**Corresponding ball check valves, Fig. 160, with same ratings, also available.**

**DIMENSIONAL DETAILS OF EDWARD Fig. 158 and 160 HYDRAULIC VALVES**
**For power, petroleum, chemical process, marine, technological or general industrial service**
**Rating 6000 lb at 125 F**
**Globe type, screwed or socket welding ends**

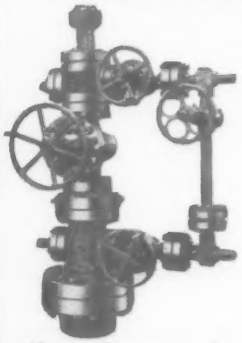
| SIZE | ¼" | ⅜" | ½" | ¾" | 1" | 1¼" | 1½" | 2" |
|---|---|---|---|---|---|---|---|---|
| End to End, Fig. 158 and 160 | 3¾ | 3¾ | 3¾ | 4½ | 5⅛ | 6½ | 7½ | 9 |
| Center to Top Open, Fig. 158 | 8¼ | 8¼ | 8¼ | 9¼ | 10⅞ | 13¾ | 14⅞ | 18 |
| Handwheel Diameter, Fig. 158 | 5⅜ | 5⅜ | 5⅜ | 6⅜ | 8½ | 10⅛ | 10⅛ | 11½ |
| Weight—lbs, Fig. 158 | 3¼ | 3¼ | 4¾ | 7 | 12 | 22 | 37 | 62 |
| Weight—lbs, Fig. 160 | 1½ | 1½ | 2¾ | 4½ | 7¼ | 13½ | 19¾ | 40 |

**THE EDWARD VALVE & MFG. CO., INC., 40 W. 144th Street**
**East Chicago, Indiana**



# EDWARD *Steel* VALVES

● BREWSTER *Pre-Tested* WELL ASSEMBLIES



Refer to our illustrated section in the COMPOSITE CATALOG

The performance of each assembly is proven by pre-testing with cold water at the prescribed pressure for 72 hours. Our engineers will be glad to show you records of typical installations, and develop an assembly to fit your exact needs.

**The BREWSTER COMPANY, INC.**

SHREVEPORT, LOUISIANA, U. S. A.

EXPORT:
Acme Well Supply Co., 19 Rector St., N.Y.C.

Brewster proudly flies the Army-Navy "E" Flag, awarded for high achievement in war production.

**PROVED IN PEACE—IN WAR**

'BESTOLIFE Lead Seal Joint Compound has been used successfully in the Oil and Refining industries for the past fifteen years. During that time, it has proved itself superior in protecting threads and in providing tight joints which can be broken out easily.

Today, 'BESTOLIFE has enlisted in the Navy, Merchant Marine and Defense Plants for the duration, and we are proud of this assignment to help in the Victory effort.

But there are still ample stocks of 'BESTOLIFE available on any priority rating, at supply house field stores in every drilling district in the United States and Canada. Use 'BESTOLIFE Tool Joint Compounds for best results!

MANUFACTURED BY

**I. H. GRANCELL**
1601 EAST NADEAU STREET
LOS ANGELES 1, CALIFORNIA


## Among the

# Drilling Contractors

**Olsen Drilling Co.,** Midland, Tex., has contract to drill 5,600-ft. wildcat in southeast Gaines County, Texas, for Northern Ordnance Co., which has located 1 Birge, C SE SE Section 1, Block C-43, Public School Land.

**Cron & Gracey,** Houston, Tex., have been awarded contract to drill Barnsdall Oil Co. 1 R. Kuntz in the Gibson field of Terrebonne Parish, Louisiana. The test is 330 ft. south and west of NE cor. SE 34-17s-15e, and is a 10,000-ft. project.

**Parker Drilling Co.,** Houston, Tex., has contract for Atlantic Refining Co. 1 Drumm in the Neale field of Beauregard Parish, Louisiana, 660 ft. south and 670 ft. west, SE cor. NE 25-3s-11w. It is a 12,000-ft. Wilcox test.

**Morris-Hamilton Drilling Co.,** Houston, Tex., is to drill Gulf Refining Co. 2 Vinton Petroleum Co., SE NW 34-10s-12w, at Vinton, Calcasieu Parish, Louisiana, having just completed the company's 1 Vinton in that field. In the meantime the 1-D M. Gray et al, same section, is being drilled before moving rig to the 2 Vinton location.

**Nicklos Drilling Co.,** Houston, Tex., is the contractor on Continental Oil Co. 4 Acadia Parish School Board, 16-7s-1w, North Richie field, Acadia Parish, Louisiana. It is a proposed 8,600-ft. test.

**Jack W. Frazier,** Houston, Tex., is completing J. M. Frost 4-A fee well in the Fig Ridge field, Chambers County, Texas, and probably will move this same rig to Frost 3-A fee location in the same area.

**McCarthy & O'Brien,** Long Beach, Calif., drilled the discovery well in a new field in San Luis Obispo County, California, for the Los Nietos Co. This was McCarthy & O'Brien's first contract well. They have started a second well for the Los Nietos Co. on the Elkins property in the Bardsdale district in 5-3n-19w, and will then swing back to Arroyo Grande for a second well in that field. The English translation of Los Nietos is grandchildren. The grandchildren involved are those of the late E. L. Doheny who pioneered in several California fields as well as in Mexico and dug by hand the first commercial well in the Los Angeles City field in 1892. R. S. Lytle is operating manager for Los Nietos Co. as well as for other affiliated interests.

**Texon Drilling Co.,** San Antonio, Tex., is drilling below surface casing in R. T. Wilson 1 Mary Louise Quota, a wildcat in the John Douglass Survey, 6 miles east of Yoakum in Lavaca County, Texas. It is an 8,000-ft. Wilcox test.

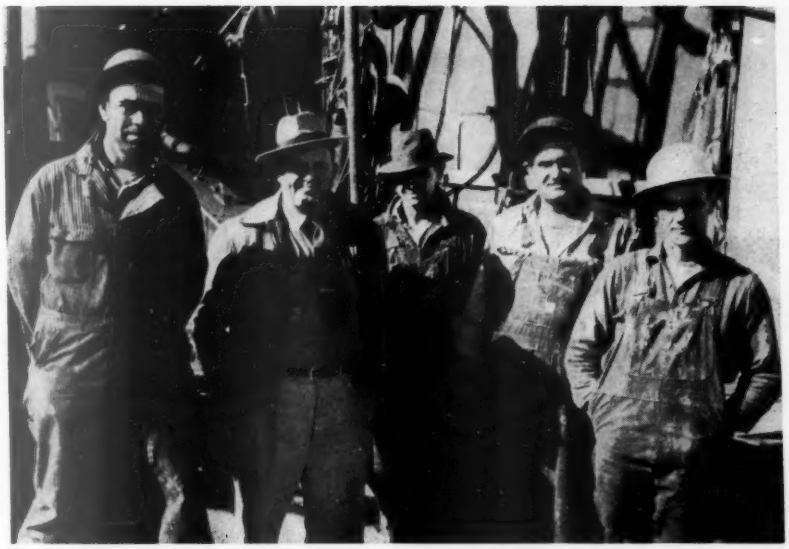
**Loffland Brothers Drilling Co.,** Tulsa, will drill the Great Lakes Carbon Corp. 1-A Yturria Land & Livestock Co. wildcat in Cameron County, Texas, on Lot 25, Santa Isabel grant. Contract depth is 11,000 ft. This test is 400 ft. southeast of the 1 Yturria cratered hole on a 6,616-acre lease, 5 miles southwest of Port Isabel.


BUILD FOR VICTORY *with* DEVIL DOG Nº 4

*No. 4 Devil Dog A. P. I. 4*

YOUR service records will show that Jeffrey's 65 years of chain-building experience makes this the superior chain both in war and peace.

THE JEFFREY MFG. CO.
891-99 N. FOURTH ST., COLUMBUS, O.
Texas Sales Office: 6358 Auden St., Houston



*Day-tour crew of Brinkenhoff Drilling Co. on rig running in Oregon Basin field, Park County, Big Horn Basin district, Wyoming. Left to right: George Campbell; Younse Boles, toolpusher; W. E. Britt, driller; L. L. Carnathan, and Ralph Thompson*

**Drilling & Exploration Co.,** Los Angeles, Calif., running 11 strings of tools in California, will have a new well for the Paloma unit plan very soon as 54-33, in 33-31s-26e, is in the pay and scheduled for immediate completion. This well will be followed into production a short time later by No. 58-3, in 3-32s-26e, drilled by the same contractor.

**Longhorn Drilling Co.,** San Antonio, Tex., has been awarded contract to drill Atlantic Refining Co. 1 J. W. Atkinson. This wildcat is in the Loma Alta area, Martha J. Dean Survey 13, A-657, on the north flank of the old Loma Alta field, 8 miles west of Brazil, in McMullen County, Texas. It is a 9,000-ft. Wilcox test.

**W. Spencer Cook,** Allegan, Mich., has assigned his own tools to 1 Benjamin Albers, in NW NE NE 30-4n-14w, Ottawa County, Michigan.

**Union Rotary Drilling Co.** and **Eugene Hilliard** will drill 1 George W. Woods estate in SW SW SW 14-22n-7w, Missaukee County, Michigan. Hilliard is owner of the well.

**Roy R. Powers,** Mount Vernon, Ill., has received contract for drilling Bur-Kan Petroleum Co. 1 C. W. Wheeler, N½ SE NE 33-5s-7e, 5 miles south of the Bungay field, Hamilton County, Illinois.

**Gordon Oil Co.,** Mount Pleasant, Mich., has been awarded the contract to drill 1 Adelaide, in C S½ NE SE 7-24n-5w, Mecosta County, Michigan, for Paul D. Cholette, trustee, and Smith Petroleum Co., Grand Rapids, Mich.

**Fisher-McCall Oil & Gas Co.** has the contract to drill 1 Hugh and Emma McDougall in NE SE NE 23-2n-12w, Allegan County, Michigan, for Southwest Development Co., Grand Rapids, Mich.

The war front needs all the rope that manufacturers can produce. Therefore, by utilizing all of your old rope and short ends, you are automatically releasing more rope to our armed forces — the men who need it most. Remember, if it's rope — USE IT UP, WEAR IT OUT or MAKE IT DO.

NEW BEDFORD CORDAGE CO.
233 Broadway, New York
31 St. James Ave., Boston, Mass.
Mills: New Bedford, Mass.

4984

Assembled Liner
Reduced Size

100% HARDNESS UNIFORMITY

is assured with MacClatchie "Money-Saver" Pump Liners . . . Every liner must pass rigid testing method covering *entire inner surface,* which reveals any soft spots that would cause breakdown and premature wear.

Uniform wall thickness on all "Money-Savers"—including reduced sizes—lowers handling weight . . . saves money on export shipments. Wear-free gland can be used over again—you need buy *only* the liner itself when renewing "Money-Savers." QUALITY is the reason more MacClatchie Liners are in use today than any others!

*Write for Descriptive Literature*

MacCLATCHIE MANUFACTURING CO.

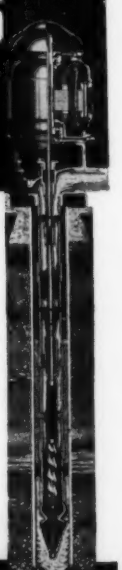
COMPTON, CALIFORNIA

*Mid-Continent Distributor:*
HAKE TOOL COMPANY, Houston, Texas
*Rocky Mountain Representative:*
MOUNTAIN SALES & SERVICE CO., Casper, Wyoming
*Foreign:*
GEORGE R. WOODS, 17 Battery Place, New York, N. Y.

All the water you need with

PEERLESS PUMPS

10 to 200,000 gallons per minute



The Peerless HI-LIFT shown utilizes single water lifting member consisting of hard chrome helical rotor revolving at half usual shaft speed within resilient cutless stator bearing. Hypocycloidal action literally squeezes water upward. 4" wells or larger. 500 to 3500 gallons per hour.

Licensed under R. Moineau's Patents, U.S. 1892217 and 2028407.

PEERLESS PUMP DIV.
*Food Machinery Corp.*
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# *Airetool* TUBE CLEANERS

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## *HERE'S WHY . . .*

One of the outstanding features of Airetool Cleaners is the New Form Cutters which eliminates the tendency to *track* which results in damage to tubes and necessary expensive, time-wasting removal. The cutters are made of special heat treated alloy steel for longer life. Airetool Cleaners are for ½" to 24" I.D. tubes, also for Catalyst Reactor units and for cleaning between the tubes in a heat exchanger bundle.

## *and HERE'S WHY . . .*

Another feature is the unique Airetool Motor—cut-away view right—which developes 28% more power and has many advantages . . . constant torque at low speeds; no dead centers; can be loaded down to 50 r.p.m. without stalling and, as soon as the load is released will start immediately. The motor is made of special wear-resistant alloy steel. Its slip-fit construction permits the motor to be taken down and reassembled on the job without special tools. *Save time, save labor, save tubes . . . investigate Airetool Cleaners.*

TUBE EXPANDERS in a variety of sizes to meet every need, COMBINATION BORING AND CUT OFF TOOLS, FLYCUTTERS, CALIPERS, TUBE JIGS, POLISHING and BUFFING MOTORS are other Airetool Products. Write for information.

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# PERSONALS

## Colorado Interstate's Manager Raised To President

THE recent advancement of Robert W. Hendee to the presidency of Colorado Interstate Gas Co. by the board of directors, meeting in New York, centralizes executive control of the company in Colorado Springs, Colo. Hendee becomes also a member of the board.

Colorado Interstate is one of five natural-gas companies of which Standard Oil Co. (N.J.) was obliged to divest itself at the direction of Securities and Exchange Commission. The stock of the five companies now is held by the newly organized Consolidated Natural Gas Co.

The new head of Colorado Interstate was born in Rochester, N. Y., in 1895 and graduated from high school in East Orange, N. J. Shortly after receiving his degree in mechanical engineering from Cornell University he became a consultant in natural-gas and natural-gasoline engineering in Tulsa. In 1921 he joined Oklahoma Natural Gas Corp. as superintendent of the gas-measurement division. The company named its Hendee station in recognition of his service in developing its transmission and distribution system. He was promoted to executive vice president and in 1932 was chosen president. He resigned that post in 1936 to become manager of Colorado Interstate, which operates a pipe line from the Texas Panhandle to Denver, Colo.

Hendee was chairman of the natural gas section of American Gas Association in 1937. He is married, has three children and has resided in Colorado Springs since 1936.

**H. Stewart Merriman** has been made manager of the lubricating department of Socony-Vacuum Oil Co., Inc. Merriman succeeds **William H. Correa,** who has been named director of the Washington, D. C., office of the company.

**G. S. Burson,** Houston, Tex., assistant superintendent of the land department, southern region, Continental Oil Co., is resigning January 1, 1944, to enter the oil business as as independent operator. He will be associated with **J. F. Lucey** of Dallas and will center his activity primarily in South Texas.

**H. W. Rhode** has been appointed scout for Tide Water Associated Oil Co., at Midland, Tex. He succeeds **James Fitzpatrick,** who returned to Illinois to reenter another business.

**Morgan J. Davis,** geologist for the Humble Oil & Refining Co., will deliver on January 13 the first of a series of oil and gas lectures to be given under the sponsorship of South Texas School of Law, Houston, Tex. His subject will be "The Geology of Oil and Gas." Other Houston lawyers who will appear on the course are **Judge E. E. Townes,** former vice president and general counsel for Humble; **James L. Shepherd,** of Baker, Botts, Andrews & Wharton; **Herman P. Pressler,** Humble; **T. J. Lawhon,** the Texas Co.; **A. W. Bounds,** Stanolind Oil & Gas Co.; **J. Q. Weatherly,** Humble.

**Frank Phillips,** founder and chairman of Phillips Petroleum Co., announced last week that plans had been completed for construction after the war of a large recreational and educational center in Bartlesville, Okla., headquarters of the company. Plans contemplate facilities for group meetings, dances, and banquets. There will be a library, writing room, motion-picture equipment, and lounges. A big swimming pool will be converted in winter into a skating rink. Bowling alleys, a gymnasium, etc., will be provided.

**Sgt. Gilmer Ellis,** formerly employed on the vertical stills of Texas Co. at its Port Arthur, Tex., works, has received a citation for the Legion of Merit for devising a tree mount for use in firing the .30-caliber light machine gun, greatly increasing the value of this weapon in wooded areas where undergrowth prohibits its use on the standard mount.

**Frank W. Bennett,** president of Red Bank Oil Co., has been chosen president and director of Seatex Oil Co., Dallas, Tex., control of which was acquired recently by Red Bank.

**Robert E. Kepke** and **H. A. Eklund,** officials of British-American Oil Producing Co., Tulsa, have been advanced

*ROBERT E. KEPKE*

*H. A. EKLUND*

to higher posts. Kepke, who has been executive assistant to **H. C. Arnold,** executive vice president, becomes vice president and manager of Toronto Pipe Line Co., transportation unit of British-American. Eklund, who has been superintendent of the land department, becomes vice president in charge of that department. He joined British-American in 1939, following a broad experience as a land man. Kepke resigned as assistant attorney general of Texas in 1941 to join British-American as its Texas attorney. He was transferred to Tulsa the next year.

**Mary Mallon,** attorney for National Petroleum Association, was married to **Joseph Warren Barker** at Washington, D. C., December 11.

**Lt. (j.g.) E. H. Barnard,** lubrication engineer in the general office of Standard Oil Co. (Indiana), Chicago, was sent to Fort Schuyler, N. Y., to take an indoctrination course.

**Maj. I. B. Donalson,** draftsman for the Texas Co. in Tulsa when he entered war service, has been awarded the Air Medal for meritorious service in flights over enemy-occupied territory in Europe. Previously he had received the Distinguished Service Cross, the Silver Star with two Oak Leaf Clusters, and the Distinguished

Flying Cross, for service in the Pacific war theater.

**J. B. Pate** has been appointed superintendent of Union Oil Co. of California's southern division pipe-line system and **R. V. Rosporough** has taken over the duties of **C. S. Wimpress,** who was relieved in order to devote full time as secretary of PAW's refining committee for District 5.

**J. Bertram Fisher,** formerly executive vice president and assistant general manager of Kendall Refining Co., Bradford, Pa., was elected president at the annual meeting of the board of directors. He succeeds **Otto F. Koch,** who resigned after serving as directing head since 1906. Others elected are **Joseph H. Bovaird** and **Don T. Andrus,** vice presidents; **Samuel J. Brill,** secretary; **Harry W. Jackson,** assistant secretary and assistant treasurer.

**L. M. Pittman,** of Balmorhea, Tex., has joined the Midland office of Texas Railroad Commission, to work in the field. He formerly was field inspector for the commission at Kilgore.

**C. Z. Webb,** former refinery superintendent for St. Helens Petroleum Co., until the plant was shut down and who has been in the employ of California Shipbuilding Co. for the past 2 years, is back in the oil business as superintendent of a plant operated by **Dr. Ulric Bray** and himself at Santa Fe Springs, Calif.

**H. D. Collier,** president of Standard Oil Co. of California, has been elected a director of the California State Chamber of Commerce.

**Wesley F. Wright** has been appointed general manager of the Dallas, Tex., division of Lone Star Gas Co., to succeed **Richard G. Soper,** who retired recently. Wright was operating manager under Soper. **Chester L. May** was named general supervisor of all distribution properties in the system.

**Ralph B. Lloyd,** president of the Lloyd Corp., Ltd., was reelected president of the California Oil and Gas Association for a third term at the December meeting of the directors in Los Angeles last week. **A. C. Mattei,** president of the Honolulu Oil Corp., and **Reese H. Taylor,** president of the Union Oil Co. of California, were elected vice presidents. **C. A. Johnson,** president of the Holly Development Co., was elected treasurer. **F. E. Foster** continues as managing director, and **D. S. Kilgour** as assistant manager.

**Dr. Carl Shipp Marvel,** professor of organic chemistry in University of Illinois, has been elected president of American Chemical Society for 1945. He will take office as president-elect January 1, 1944, when **Dr. Thomas Midgley, Jr.,** vice president of Ethyl Corp., becomes president of the society, succeeding **Dr. Per K. Frolich,** director of the chemical division, Esso laboratories, Standard Oil Development Co. **Dr. Robert E. Wilson,** New York, president of Pan American Petroleum & Transport Co., and **Prof. Roger Adams,** head of the department of chemistry in University of Illinois, were chosen directors. **Dr. Ernest H. Volwiler** of Abbott Laboratories, Chicago, was named director at large.

**Charles K. Schwartz** has resigned as counsel for District 2, Petroleum Administration for War, after 27 months of service, to return to his private law practice in Chicago. **W. W. Vandeveer,** director in charge, said the resignation was accepted because Schwartz had completed the particular work he had agreed to undertake. **Faner C. Wenderly,** assistant counsel, will serve as acting district counsel.

**W. G. Skelly,** president of Skelly Oil Co., Tulsa, has been chosen a director of National Association of Manufacturers, comprising more than 9,000 industrial managers, representing virtually every type of industry.


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# Market Developments

## East Coast

NEW YORK.—Even though the East Coast stocks of residual fuel oil have declined almost 20 per cent in the past 2 months, PAW spokesmen viewed it as "normal" and dismissed any concern over the prospects. This viewpoint was expressed in a statement last week by Secretary Ickes and susbtantiated by the OPA action in allowing resumption of rations for oil for spraying coal.

Further moves designed to combat the black market in gasoline stamps were taken. In New York automobile sellers were required to relinquish unused stamps before the sale of the car is permitted.

Except for the decline in residual fuel-oil stocks, the supply situation in District 1 remains generally satisfactory. Kerosene is somewhat weaker but light heating-oil inventories continue to improve.

## Mid-Continent

EASTERN buyers were begging Mid-Continent refiners and marketers for kerosene, but stocks were already below customary working levels. Light lubricants continued to be obtainable at less than ceiling prices, the sole exception to extreme tightness which characterized refinery products. Wintry weather in northern areas increased the appeals for heating oils.

Sales of light lubricating oils below ceiling prices were reported, but stocks, refiners, said, were not rising in such way as to cause concern. All-purpose gasoline was in vigorous demand by government agencies, and there was no sign of any relaxation in the requirements of all classes of buyers. The situation with reference to this commodity in the Mid-Continent territory was characterized this week by District 2 officials as "extremely critical."

## Pacific Coast

LOS ANGELES, Calif. — California markets were comparatively inactive this week only a few small sales being recorded. Retail service stations, reflecting the establishment of sales quotas by supplying companies, are finding it difficult to operate efficiently under reduced volume.

Obviously some corrective measures will ultimately be taken and if civilian consumption is further reduced it is likely that the first step will be a cut of 1 gal. in A coupons. This will not entirely solve the situation and will probably be supplemented by the designation of key stations to serve defense industries.

A temporary shortage of refining capacity has been rectified to a large extent by the conversion of certain distillation equipment and the tying in of these facilities with newly constructed cracking units.

Marketing conditions on the Pacific Coast will reach the critical stage early next year, the exact time depending upon how much of a reduction can be effected during the winter period in civilian consumption.

## Gulf Coast

HOUSTON, Tex.—Necessity of accumulating substantial stocks of refinery products for delivery to the East Coast through the 20-in. WEP line is, along with sustained calls from established customers, placing additional supply burdens on Gulf Coast plant operators. Supplies of civilian motor fuel available for unrestricted distribution are being consistently reduced because of completion of new aviation-gasoline facilities. Hardly a week passes without one or more refiners withdrawing offerings of at least one grade of civilian gasoline.

Demands for kerosene from the eastern seaboard are going unsatisfied although shipments from the Gulf Coast have been increased regularly since the start of December. The relief granted last week in kerosene specifications will, coastal plant operators assert, permit them greater flexibility in shipping required quantities to the East Coast.

Details had not been received this week but refiners here understood that the liberalized specifications will permit inclusion of higher boiling fractions which previously were rejected from the kerosene cut and included in distillate fuel oil. Because Gulf Coast plants are the largest source of kerosene supplies, this modification has more tangible significance here than elsewhere.

## A.P.I. REFINERY REPORT

**Week ended December 18, 1943**

(Figures in thousands of barrels)

| | Dly. crude runs to stills | Stocks: Gasoline | Stocks: Residual | Stocks: Gas oil |
|---|---|---|---|---|
| Appalachian | 138 | 2,812 | 352 | 976 |
| Ind., Ill., Ky. | 739 | 14,115 | 2,677 | 6,136 |
| Okla., Kan., Mo. | 328 | 6,767 | 971 | 2,203 |
| Censored area* | 2,110 | 33,499 | 16,494 | 22,957 |
| Rockies | 99 | 1,321 | 690 | 402 |
| California | 732 | 14,211 | 37,088 | 11,443 |
| Total 12-18-43 | 4,146 | 72,725 | 58,272 | 44,117 |
| Total 12-11-43 | 4,144 | 71,937 | 59,715 | 45,510 |
| Total 12-19-42 | 3,645 | 76,141 | 74,449 | 47,165 |

*Reports combined on East Coast, Texas Gulf Coast, Louisiana-Arkansas and Inland Texas at request of PAW.

### CRUDE-OIL STOCKS

(Bureau of Mines Estimate)

| Week ended: | Bbl. of crude* |
|---|---|
| December 18, 1943 | 245,795,000 |
| December 11, 1943 | 240,148,000 |
| December 19, 1942 | 231,742,000 |

*Excludes unrefinable California stocks.

## REFINERY PRICE SUMMARY

**(Prices as of December 28, 1943)**

**Quotations are f.o.b. plant in cars and in cents per gallon except where otherwise noted. They are exclusive of the federal excise taxes of 1.5 cents a gallon on gasoline and 4.5 cents a gallon on lubricating oils, and do not include marine lighterage charges.**

### REFINERY GASOLINE

| Octane (A.S.T.M.): | 80† | 72-74 | 68-70 | 63-66 |
|---|---|---|---|---|
| Mid-Continent* | ‡6.00-6.25 | 5.750-6.000 | ..... | 5.625 |
| Gulf Coast | 6.00-6.50 | §5.750-6.250 | §5.750-6.250 | §5.250-5.750 |
| Northeast Coast | 9.80 | 9.2 | 9.2 | ..... |
| California | ..... | 6.255-6.500 | 5.750-6.125 | 5.125-5.500 |

*Basis Group 3. †1939 C.F.R. (research method). ‡Inland Texas and adjoining counties in Arkansas and North Louisiana. §Unleaded.

### KEROSENE AND DISTILLATE FUEL OIL

| Product— | Kerosene† | No.2 | No. 3 | No. 5 | No. 6‡ |
|---|---|---|---|---|---|
| Mid-Continent* | 4.125-4.375 | 3.500-3.625 | 3.375-3.500 | $0.85 | $0.80-1.27 |
| North Louisiana* | 4.125-4.375 | 3.500-3.625 | ..... | ..... | 0.80-1.27 |
| Pennsylvania | 6.000-6.125 | 5.875-6.125 | 5.875-6.000 | ..... | ..... |
| California | 4.500-5.500 | 5.500 | 5.500 | §1.10-1.25 | ¶1.10-1.15 |
| Northeast Coast | 6.800 | 6.700 | 6.700 | 1.95 | 1.65 |
| Gulf Coast | 4.125 | 3.750-3.875 | ..... | 1.35 | 0.85 |

*Reflecting OPA ceilings, depending on destination of shipments. †Quotations for 41-43 gravity. ‡Range depends on gravity. §Pacific Specification 300. ¶Pecific Specification 400.

### NATURAL GASOLINE

| Grades: | 26-70 | 18-55 |
|---|---|---|
| Oklahoma (Group 3) | 4.750 | 5.700 |
| North Texas | 4.375 | 5.250 |
| North Louisiana | 4.375 | 5.250 |
| California | 4.875 | 5.500 |

# AMONG EQUIPMENT MEN

## Wilson Made Representative For Weatherford Spring Co.

F. M. (Peanuts) Wilson is the newly appointed representative of Weatherford Spring Co., for North Central Texas, with headquarters in Wichita Falls. Wilson was with Decker Tool & Supply Co. for more than 9 years, but has more recently represented oil-field-specialty manufacturers in Texas.

## New Personnel Appointments At Gardner-Denver Co.

R. H. Rodolph has been appointed manager of the pump and compressor division of the Gardner-Denver Co., Quincy, Ill., following the death of R. J. MacFarland. Rodolf's connection with the company dates back to August 1917 when he joined Canadian Rock Drill Co. at Vancouver, B. C., then a subsidiary of Denver Rock Drill Manufacturing Co., of Denver, Colo.

Appointed as Rodolf's assistant is C. M. George, who joined the Gardner-Denver organization in Quincy in January 1929. With the exception of a few months spent in the armed forces with the U. S. Engineers, George's service with Gardner-Denver has been continuous in Quincy.

## Lupke Named Manager of Ross Detroit Office

A Detroit factory branch office has been opened by Ross Heater & Manufacturing Co., Inc., manufacturer of all types of tubular heat exchangers, oil and water coolers, heaters, condensers, steam jet air ejectors, tube expanders and similar equipment. Manager of the office, located at 715 New Center Building, is Frederick J. Lupke, Jr., who will devote his time exclusively to the sales-engineering of Ross equipment.

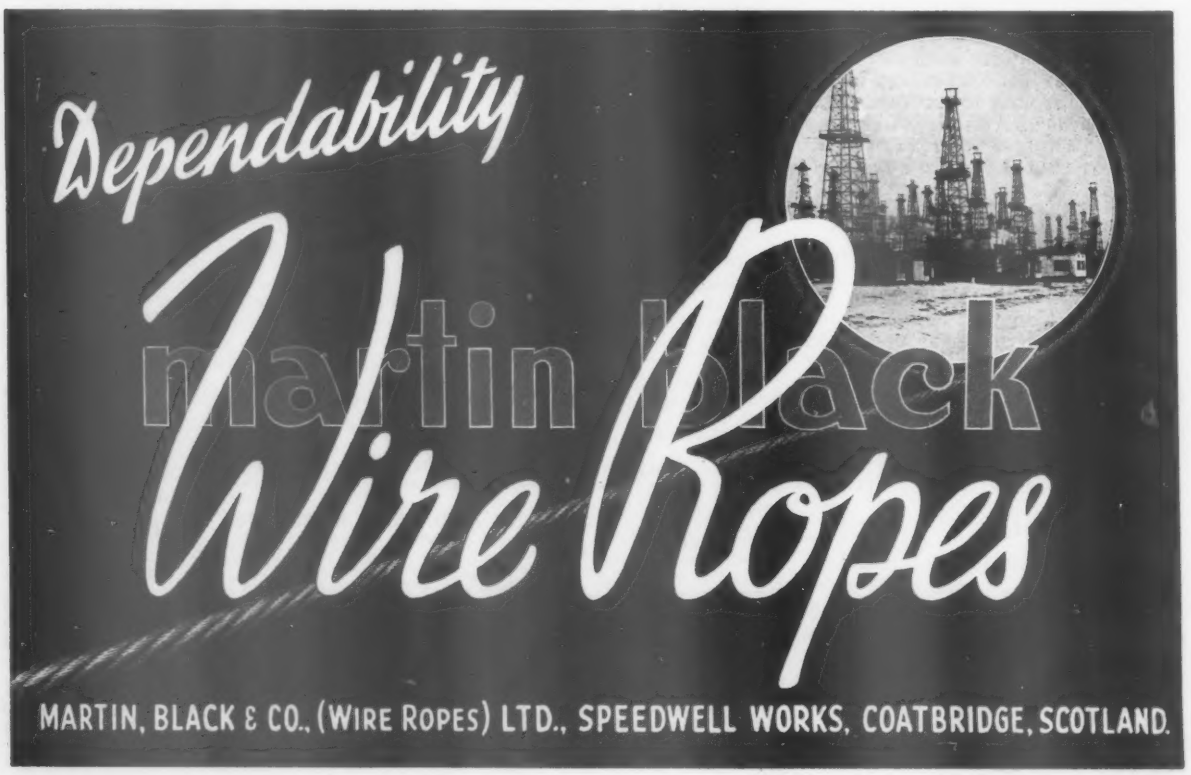
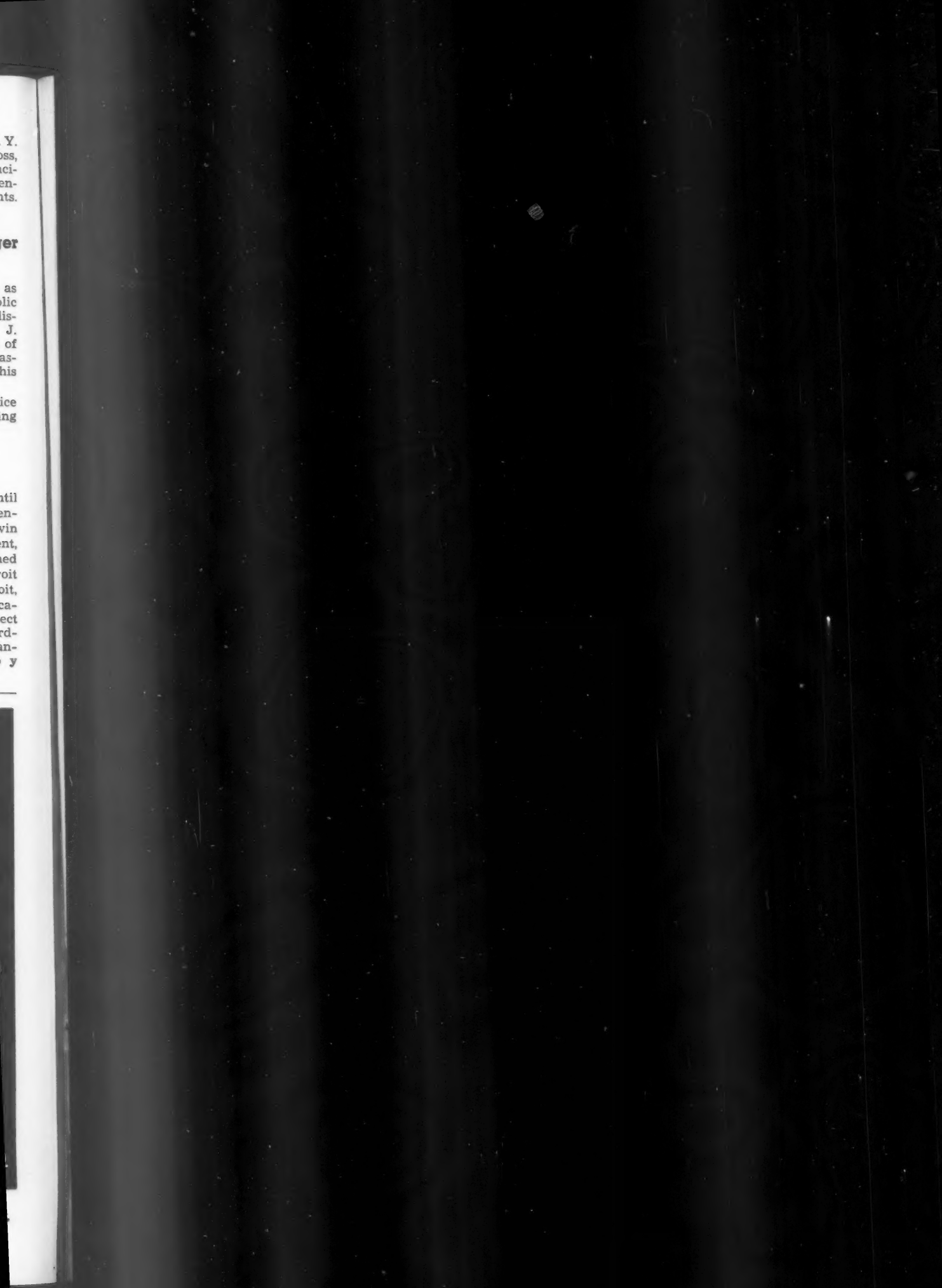
Before taking over the Detroit office, Lupke was assistant production manager of the plant in Buffalo, N. Y. Since 1937, when he joined Ross, Lupke has served in various capacities, including estimating, sales, engineering and production departments.

## Craig District Sales Manager Of Republic Steel Corp.

Appointment of Harvey A. Craig as district sales manager of Republic Steel Corp. in the Los Angeles district has been announced by N. J. Clarke, vice president in charge of sales. Arthur C. Geldner will be assistant district sales manager in this territory.

For many years Craig was vice president of Rheem Manufacturing Co., Richmond, Calif.

## Simi Joins Timken

*H. E. SIMI*

H. E. Simi, until recently chief engineer of Twin Coach Co., Kent, Ohio, has joined Timken - Detroit Axle Co., Detroit, Mich., in the capacity of project engineer, according to an announcement by W. F. Rockwell, president.